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NOVEMBER 1950

PERMANENT FILE

LITERATURE

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X-1850 2M 10-54

RECORD CAISSON FOR BRIDGE PIER

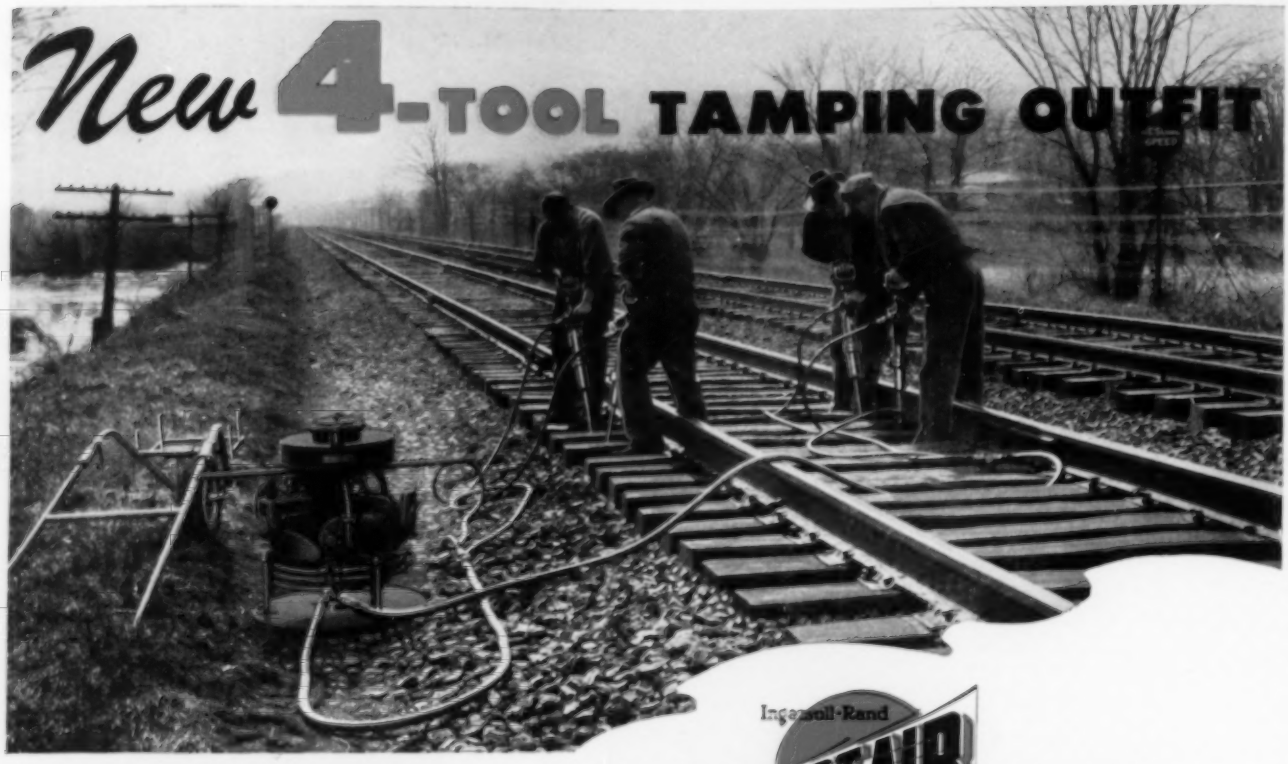
Dredging bed of Delaware River at Wilmington, Del., through 60-well structure

(SEE INDEX PAGE)

VOLUME 55 • NUMBER 11

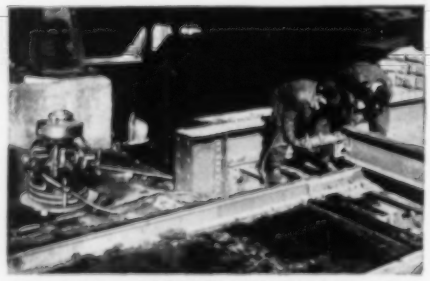
NEW YORK • LONDON

New 4-TOOL TAMPING OUTFIT



Ingersoll-Rand SPOT-AIR 3R-36

36 cfm operates four MT-4 Tampers for TRACK MAINTENANCE GANGS



Many bridge and building jobs can be speeded up with the SPOT-AIR and a few air tools.

Rock-breaking and other maintenance of way jobs are easily handled with the SPOT-AIR.

The compactness and lightweight of the SPOT-AIR make jobs in out-of-the-way places easy to get at.

The new SPOT-AIR is the lightest, most compact section-gang compressor of its kind. Its 36-cfm capacity is ample to operate 4 Ingersoll-Rand MT-4 Tie Tampers . . . or a number of other Air Tools used on signal-maintenance, grade-crossing, and numerous emergency jobs.

This 265 pound compressor stands only 32 inches high on a 27-inch baseplate. It is extremely suitable for between-track work under traffic and takes no more space than one man on a section-car.

The self-contained arrangement of three gasoline-engine cylinders and three air cylinders alternately spaced around a vertical crankshaft gives a smooth conversion of engine torque into air power. The 3R-36 is completely air-cooled, thus permitting operation in any kind of weather with no danger of freezing or overheating.

Over 600 smaller-capacity SPOT-AIR compressors, Type 3R-30, have been in successful 2-tamper operation on railroads all over the country during the past two years. The new 3R-36, which delivers full 36 cfm of free air at 80 pounds pressure, has a number of up-to-the-minute improvements which make it the most efficient and easiest to maintain compressor of its type. See your nearest I-R representative for the full story on the SPOT-AIR and Ingersoll-Rand's complete line of Air Power equipment for railway maintenance.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 564-2

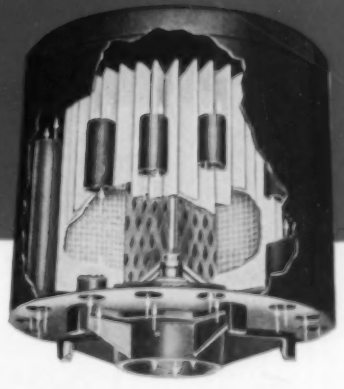
Other Air Power equipment for maintenance of way jobs

SPIKE DRIVERS • GRINDERS • IMPACTOOLS • WOODBORERS • RIVETING HAMMERS • RIVET BUSTERS • BACKFILL TAMPERS • PAVING BREAKERS • PUMPS

IT FILTERS!

IT SILENCES!

CUTAWAY VIEW



STAYNEW MODEL DS INTAKE FILTER

Both silencing and filtering in a single compact unit! All the outstanding advantages of the original Staynew Dry-Type Radial Fin Construction: low resistance to air flow; increased efficiency with use; suitability for use on carbon ring compressors; no oil, viscous coating or charging tanks; no moving parts; inserts easily and inexpensively cleaned or replaced.

Silencing is efficiently handled without excess back pressure thru a series of cylindrical rectifying chambers of scientific diameter to length ratio.

Thousands of these well-designed, well-built Staynew Filters are already in use, saving wear on compressor and internal combustion engines, reducing intake clamor.

FOR COMPLETE DETAILS WRITE:

DOLLINGER PROTECTOMOTOR FOR STAYNEW FILTERS

DOLLINGER CORPORATION

7 CENTRE PK., ROCHESTER 3, N. Y.

IN CANADA: Toronto - McCarthy and Robinson
Montreal - Engineering Equipment Co.

IN FRANCE: Paris - Société Tecalemit

doing this *costs more* now!

You do it less often

by using Dependable Quality

CRANE VALVES

That's why more Crane Valves are used than any other make

. . . this valve likes tough throttling jobs

—And for durable, maintenance-free service, it's typical Crane quality. The plug-type disc and seat construction in Crane No. 14½P's utilizes the toughest combination of metals found in 150-Pound brass valves. Extra wide seating surfaces give high resistance to damage by "wire drawing" or foreign matter. Crane disc taper is precisely correct for accurate flow regulation.

Whether you need throttling valves or any other type, you'll pay less in the long run by insisting on Crane Quality. Get a demonstration by your Crane Representative.

CRANE

CRANE CO., *General Offices:*
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

This steel will drill extra footage

It's all Bethlehem Hollow, every bar. But that's not the only reason this drill steel will last longer. The tidy method of storing reconditioned rods indicates good housekeeping and the extra care that assures maximum service life from every bar. It saves time, too.

Drill steel that is handled roughly and thrown about is likely to receive nicks which can provide the starting points for fatigue cracks that shorten its useful life. Likewise, it's unwise to allow steel to remain in acid mine water or, for that matter, to expose it to any kind of abuse or neglect.

You've got fine steel when you use Bethlehem Hollow. It's engineered to give a lot of service. That's why it's smart to give it the care its quality deserves.

Make sure you've got Bethlehem Hollow on the job. Here's why:

- ★ Ideal for either forged or detachable bits
- ★ Center hole is smooth, true, and well-centered
- ★ Wide quenching range for easy heat-treating
- ★ Controlled hardenability and grain size
- ★ Made from tough, fatigue-resisting steel

For Immediate Delivery

HOLLOW DRILL STEEL • SOLID DRILL STEEL
QUARRYING STEELS • AUGER DRILL STEEL
STONE-DRESSING STEELS

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

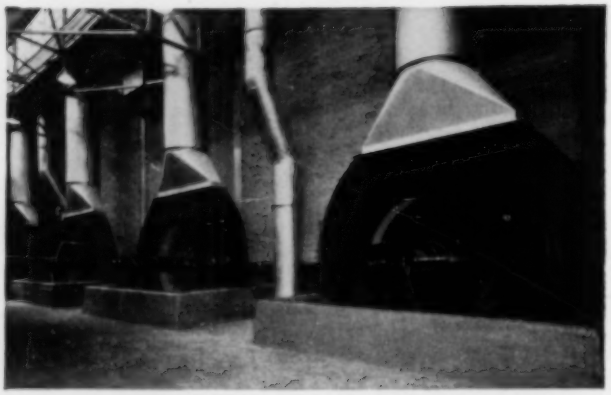
BETHLEHEM STEEL

BETHLEHEM HOLLOW DRILL STEEL

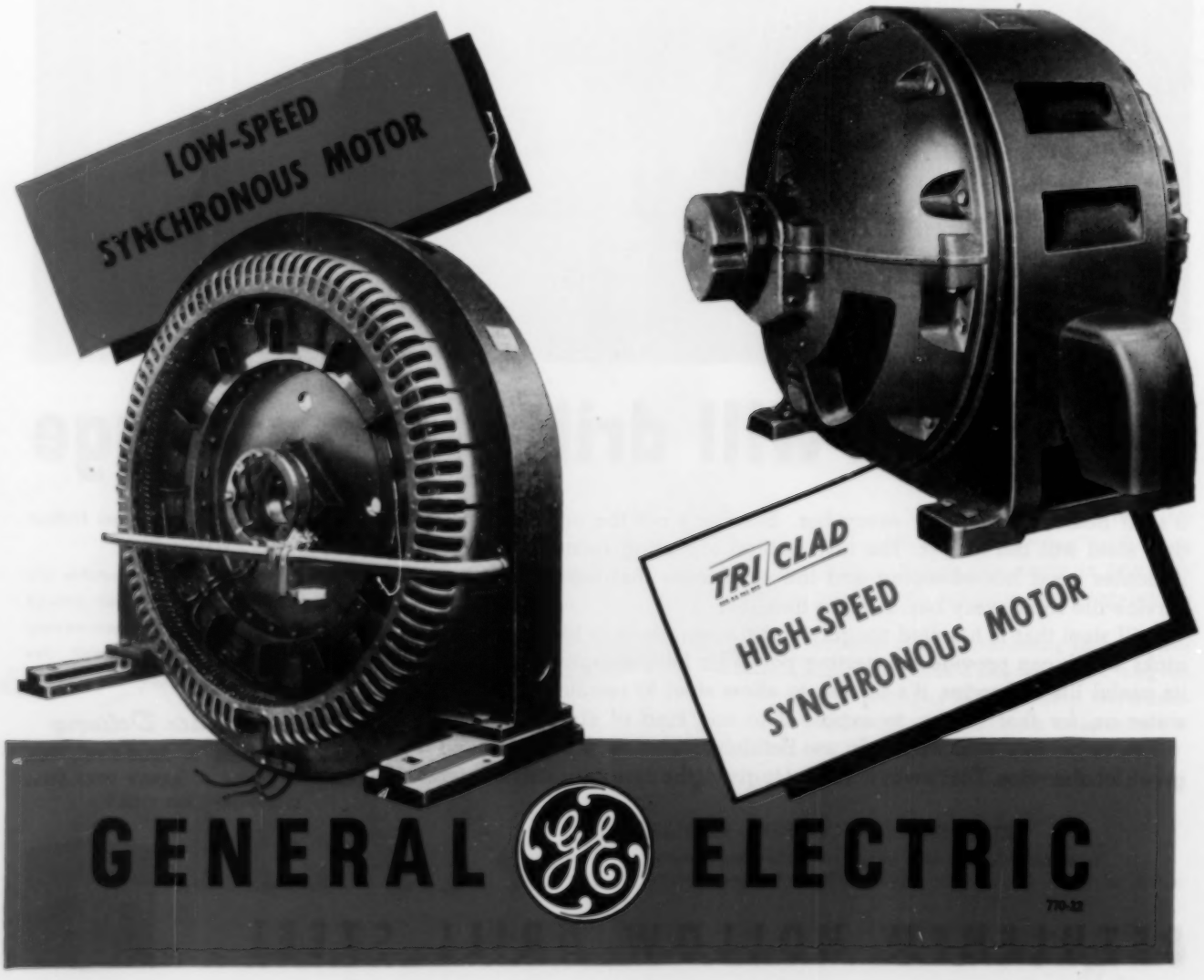
G-E SYNCHRONOUS

SAVE MONEY

SAVE ON OPERATING COSTS . . . Municipal plant gets higher efficiency by continuous operation at constant speed of three 500 horsepower, 1.0 power factor, G-E synchronous motors, each coupled to a centrifugal storm-sewer pump.



SAVE ON INITIAL COST . . . Paper mill selected this 4000 hp, 200 rpm, G-E synchronous motor for driving the montague grinders at low speed. Maximum operating efficiency thus resulted.



MOTORS CUT COSTS

. . . improve performance

IT'S ON THE RECORD . . .

Lower operating costs higher operating efficiency

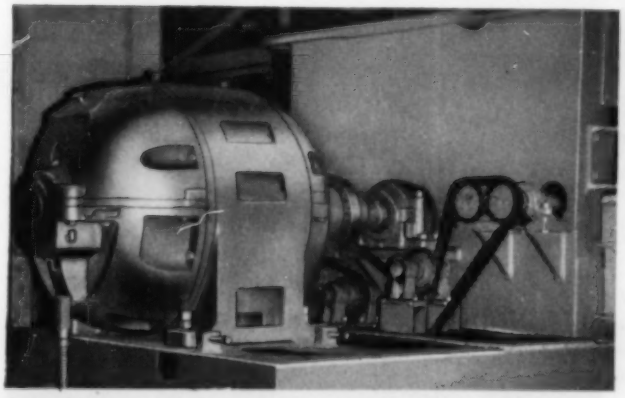
Lower initial cost including control and exciter—for many ratings

Reduced demand and release of needed generating capacity

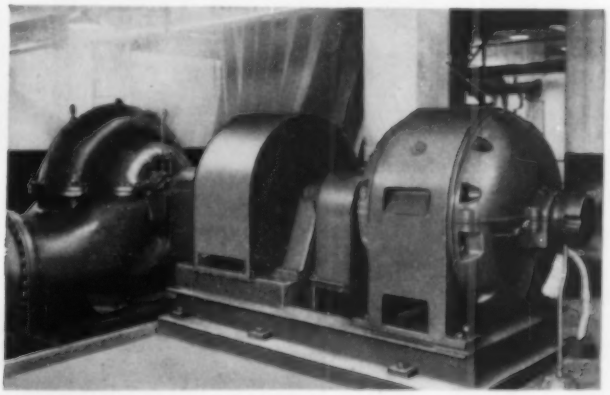
Reduced power rates for improved power factor

For your next large, constant-speed motor, ask your General Electric sales representative to tell you how you can take full advantage of the money-saving features of G-E SYNCHRONOUS MOTORS. Or write for bulletins GEA-5332 (low-speed) or GEA-5426 (high-speed) on your letterhead to *Section 770-22, Apparatus Department, General Electric Company, Schenectady 5, New York.*

GAIN EXTRA PERFORMANCE

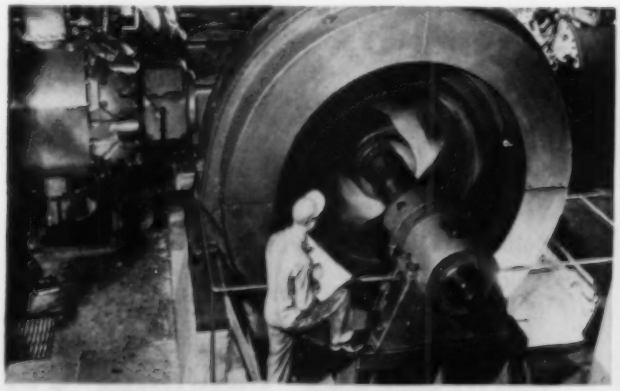


DEPENDABILITY . . . Extra protection against physical damage, electrical breakdown, and operating wear and tear makes Tri-Clad* motors highly suitable for sawmill operations. Here is a Tri-Clad synchronous motor rated 300 hp, 1200 rpm, driving an edger in an Oregon sawmill.



LONG LIFE . . . All welded steel-plate stators assure a permanently solid core, and box-type construction means a rigid frame. This 350 hp, 0.8 p.f. G-E synchronous motor, coupled through magnetic clutch, is matched to a fan pump which delivers stock to paper machine.

SIMPLIFY OPERATING PROBLEMS

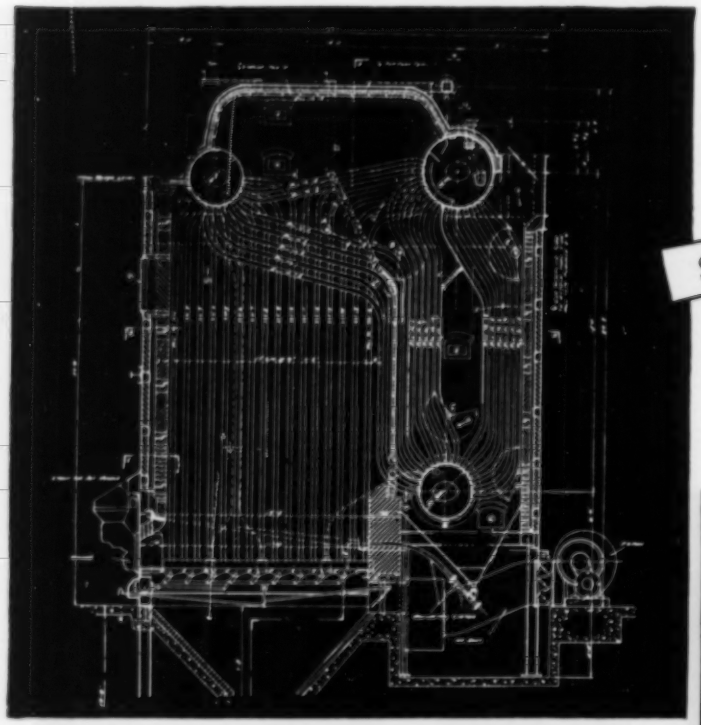


APPLICATION ENGINEERING . . . Engineers with many years of field experience will tailor synchronous motors to fit your needs. An example is this largest synchronous motor (in horsepower) ever to be applied to drive a reciprocating compressor; G-E motor rated 4500 hp, 300 rpm, driving a Clark gas compressor.

SERVICE . . . No matter where your plant is located, you will find General Electric service close at hand. Experienced engineers of our local offices, and trained staffs from our Service Shops are always at your command.

*Reg. U. S. Pat. Off.

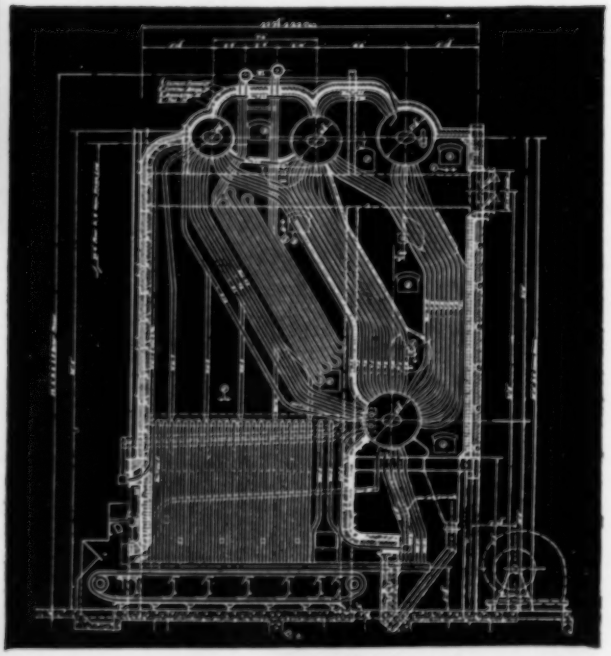
Quick Steaming at all Ratings!



Carry high overloads with high efficiency

SPECIFY **Vogt**

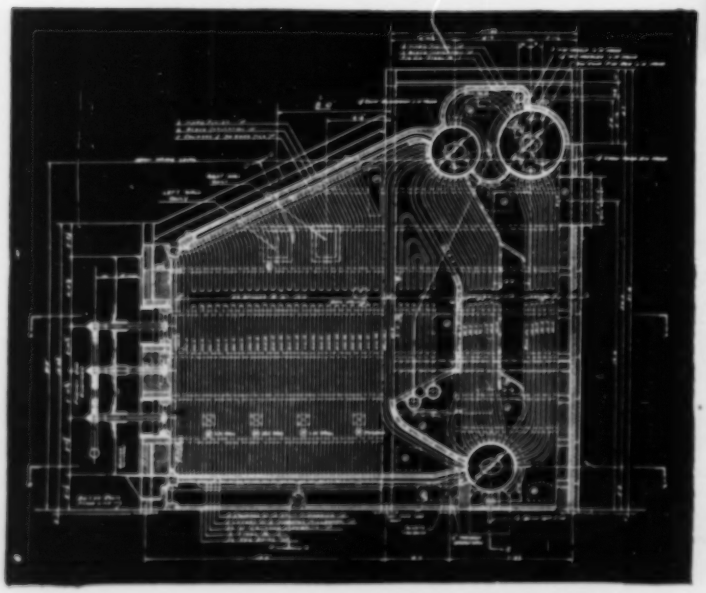
STEAM GENERATING UNITS



CLASS VL Two 27,500 pounds per hour units, installed at Brown-Forman Distillers Corporation, Louisville, Ky. Features large furnace volume in limited space, with high ratio of radiant heating surface.

CLASS LE Mt. Carmel Public Utility, Mt. Carmel, Illinois, is served by this 60,000 pounds per hour unit. Generous steam liberating surfaces and steam space permit wide fluctuations in load.

CLASS VR 70,000 pounds per hour steam generator at Humble Oil and Refining Company, Johnsue, Texas. An efficient, high-duty unit with water cooled furnace, using refinery gas fuel.



Vogt builds a complete line of bent tube steam generators, designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Bulletins with general information and showing typical installations are available upon request.

HENRY VOGT MACHINE CO.

LOUISVILLE 10, KENTUCKY

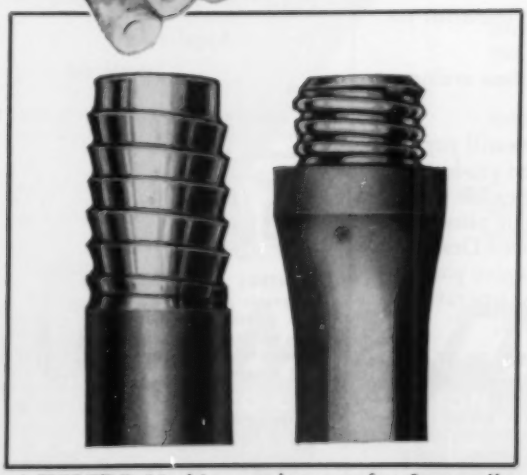
BRANCH OFFICES:
NEW YORK, PHILADELPHIA, CLEVELAND
CHICAGO, ST. LOUIS, DALLAS

THREAD your drill rods on the job with a TOLEDO *Machine*

Here's a *low-cost efficient way* to thread new or re-thread broken drill rods—use a TOLEDO 2" High Speed Rock Drill Rod Machine! Does the work *on the job*—at a fraction of cost of new rod and with minimum downtime.

An Eastern user says: "We purchased our first TOLEDO Rock Drill Rod Machine in 1939 and it proved very satisfactory. We were able to increase our production and improve our methods used for threading drill rods. As our business on these rods increased we found it advisable to purchase our second TOLEDO Rock Drill Rod Machine in 1947. We find these two machines highly efficient for threading all types of drill rods."

Can be tooled to produce Ingersoll-Rand and Timken threads. After rod is annealed the Toledo Machine will turn to size, thread and face off end of rod to a perfect fit for detachable bits. Sturdy, proven design . . . simple operation. Send for bulletin 45. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.



A TOLEDO Machine produces perfect Ingersoll-Rand or Timken threads rapidly and easily.

RELY ON THE LEADER

TOLEDO

for ROCK DRILL ROD MACHINES

Best Buy in Variable Speed!

COMPARE THESE FEATURES of *Vari-Pitch* Automatic sheave with any other variable speed drive and see why *Vari-Pitch* Automatic drive gives you more for your drive dollar.

1. Changes speeds with one hand while machine is running.
2. All mechanism is inside one sheave actuated by movement of the motor base.
3. Ample capacity and safety factor of multiple belts.
4. Full range of sizes from 1 to 40 hp.
5. Top speed is 100% higher than low speed.
6. Quiet operation.
7. Cushioned start.
8. Simple design and easy installation make cost low
9. Occupies no more space than ordinary sheave.

Vari-Pitch Automatic drive will pay for itself very quickly in increased production, improved quality and more flexible operation on many machines in your plant. Ask your Allis-Chalmers Authorized Dealer or Sales Office representative to give you savings and cost figures on your operations. Or write for bulletin 20B7223.

ALLIS-CHALMERS, 1000A SO. 70 ST.
MILWAUKEE, WIS.

Vari-Pitch and *Texrope* are Allis-Chalmers trademarks. A-3063

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

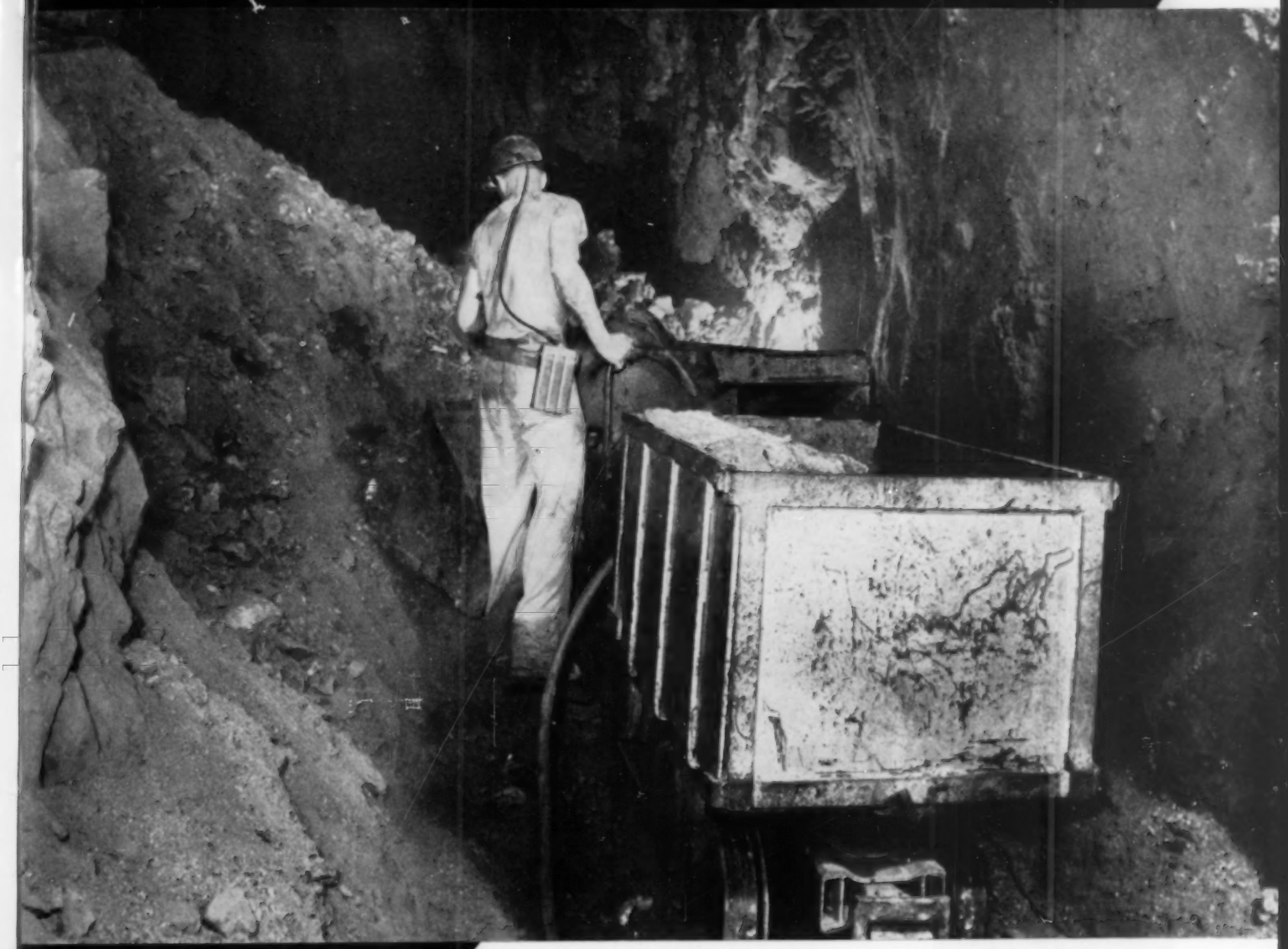
MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

ALLIS-CHALMERS

Dependable Workers



Labor shortages make the choice of rock loading equipment even more important. Its easier to get men to work when they know they'll be operating Eimco RockerShovels.

Every operator is interested in Eimcos because they're easier and safer to operate, faster in loading and more powerful for crowding into the muck pile.

Eimcos make a more profitable operation all around. They're cheaper in maintenance costs and require less air to operate efficiently. They're the choice of discriminating buyers all over the world.

EIMCO

THE EIMCO CORPORATION

The World's Largest Manufacturers of Underground Rock Loading Machines

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 8, UTAH, U. S. A.

BRANCH SALES AND SERVICE OFFICES:

NEW YORK, 51-52 SOUTH STREET • CHICAGO, 3319 SOUTH WALLACE STREET
BIRMINGHAM, ALA., 3140 FAYETTE AVE. • DULUTH, MINN., 216 E. SUPERIOR ST.
EL PASO, TEXAS, MILLS BUILDING • BERKELEY, CALIFORNIA, P. O. BOX 240
KELLOGG, IDAHO, 315 MAPLE STREET

AFFILIATED COMPANIES: SOCIETE EIMCO, PARIS, FRANCE
EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND
AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD

A2e7

You can't beat an Eimco!

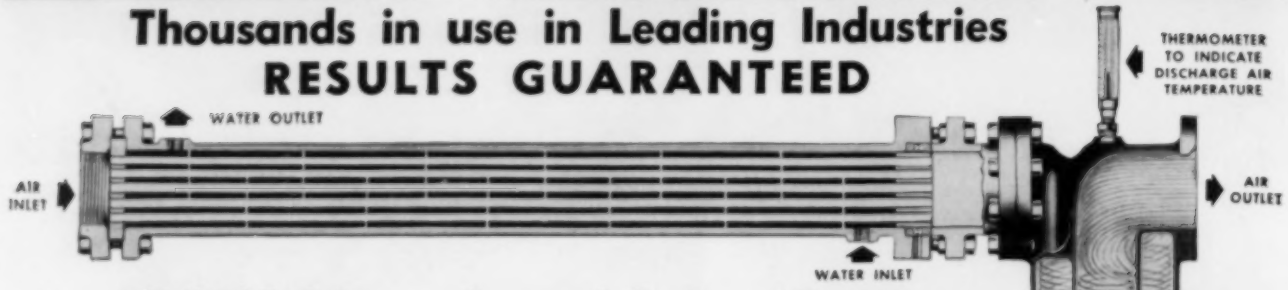
IT STAYS ON THE JOB

Complete Conditioning of Compressed Air

by ADAMS PIPELINE

AFTER COOLER and AIR FILTER

Thousands in use in Leading Industries
RESULTS GUARANTEED



ADAMS Aftercooler and Cyclone Separator

ACTION

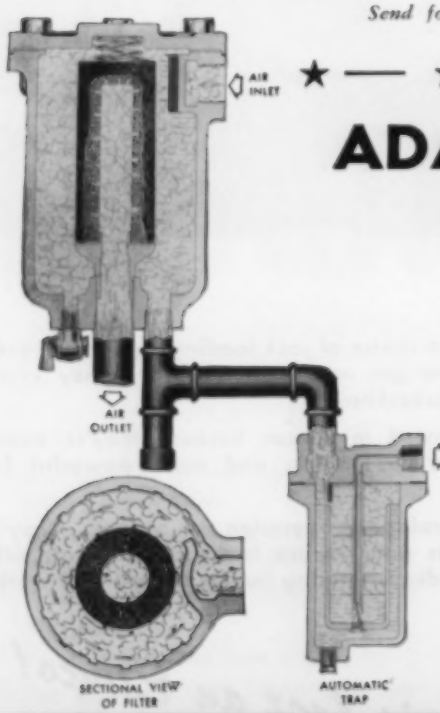
- Cools compressed air to within a few degrees of cooling water
- Through this cooling, vaporized water and oil are condensed — and completely removed by Cyclone Separator

BENEFITS

- The dry, clean air prevents failing of instruments
- Reduces wear and tear on air tools and pneumatic machinery
- Prevents freezing pipes in winter
- Prevents rust and pipe scale in distribution lines

Easy to install, no foundation required

Send for Bulletin 176



ADAMS PORO STONE Air Filters

Protect Instruments and Air Tools —Insure Better Work

The Adams Poro-Stone Filter gives continuous service without attention or maintenance expense. Efficient centrifugal separation *plus* diffusion through Poro-Stone, removes liquid and solid contamination completely without pressure loss.

Automatic Trap eliminates attention and assures continuous and efficient filter operation.

Learn how Adams Conditioning means Trouble-free use of Compressed Air

Send for Bulletin 176, and accept our 30-day FREE TRIAL on ADAMS Poro-Stone Air Filters.

R. P. ADAMS CO., INC.

209 E. PARK DRIVE
BUFFALO 17, N. Y.

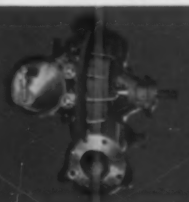
Down time due to FOUL AIR adds more to your costs...

. . . than the blower that helps men do a fair day's work

Speed fresh, cool air into a furnace, manhole, tank or other confined area where men must work and you'll get faster, better work in return.

There's a portable, easily adaptable Coppus Blower or Exhauster for just about any problem caused by stagnant, hot or fume-filled air. The Blue Ribbon stands for precision engineering that assures peak performance at lowest cost. Check and mail the coupon today for the information that fits your particular problem. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, BEST'S SAFETY DIRECTORY, MINING CATALOGS.

OTHER COPPUS "BLUE RIBBON" PRODUCTS



HORIZONTAL TURBINE
Six frame sizes—
1 to 150 horsepower

VERTICAL TURBINE
Six frame sizes—
1 to 150 horsepower

FANMIX GAS BURNER

FANMIX OIL BURNER

MAIL THIS COUPON To Coppus Engineering Corp., 211 Park Avenue, Worcester 2, Mass.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets; etc., after treated with coating material.

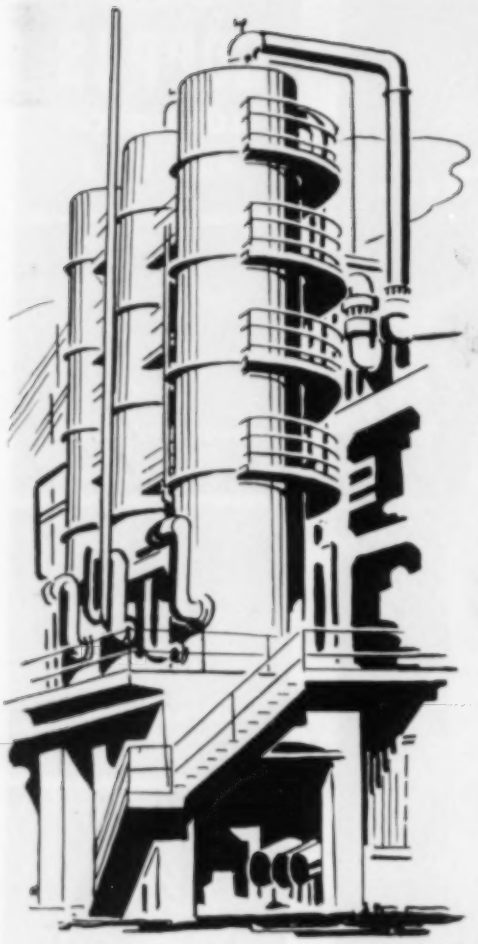
NAME .....

COMPANY .....

ADDRESS .....

CITY .....

(Write here any special ventilating problem you may have.)



554-12

How Process Plants

SAVE THREE WAYS

with

Ingersoll-Rand Turbo-Blowers

In the process industries, and wherever large volumes of air or gas must be compressed to moderate pressures, over 3,000,000 horsepower of Ingersoll-Rand Turbo-Blowers are repeatedly proving their economy and dependability.

They Save Power Costs with a highly efficient design that stays efficient year after year.

They Save Maintenance Costs because they are designed as rugged heavy-duty machines with an extra-large shaft, spherically-seated, 4-way shim adjusted bearings, full shaft sleeves . . . and many other features that mean less maintenance even under the most severe operating conditions.

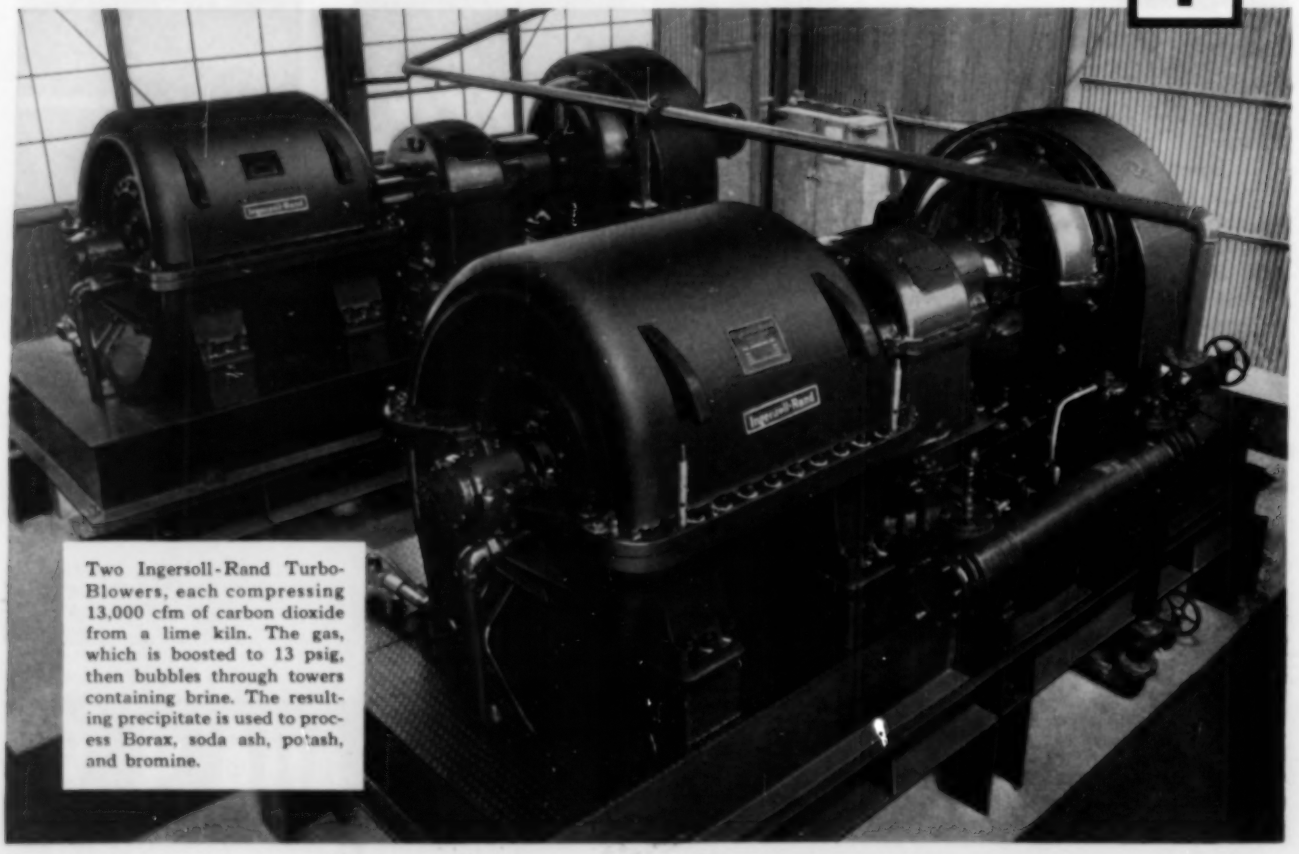
They Avoid Costly Interruptions that can shut down your entire plant. For example, one I-R 11,000 hp Turbo-Blower was opened for inspection after six war-time years of continuous service and it was in perfect condition. While we don't approve of neglecting periodic inspection, we are proud that the orginal low power consumption was not affected by use . . . that there was no costly maintenance . . . and that production was not interrupted.

Whatever your blower application, Ingersoll-Rand can design and supply the Turbo-Blower that's *right* for the job—a blower you can depend on for constant delivery of air or gas at the lowest possible cost. Sizes: to 21,000 hp, to 155,000 cfm, to 110 psig and higher.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS
CONDENSERS • CENTRIFUGAL PUMPS • DIESEL & GAS ENGINES



Two Ingersoll-Rand Turbo-Blowers, each compressing 13,000 cfm of carbon dioxide from a lime kiln. The gas, which is boosted to 13 psig, then bubbles through towers containing brine. The resulting precipitate is used to process Borax, soda ash, potash, and bromine.

"Cylinder lacquer is a costly condition that frequently develops. Lacquer prevents rings from maintaining proper contact with the cylinder wall and results in blow-by, impaired cooling, loss of cylinder pressures, improper combustion, and waste of fuel. It adds to operating costs. It creates extra maintenance problems.

"When Cook engineers encounter such a problem, they first determine the cause. Second, they suggest a remedy. Third, they recommend the most efficient ring combination for the particular operating requirements.

"Cook calls this service 'job-engineering' because it puts ring selection on a sound and scientific basis. Cook can do it because it has on hand a mass of data obtained from electronically indicating engines under all service conditions. Cook knows what to look for—knows what to expect—and knows how to correct it."

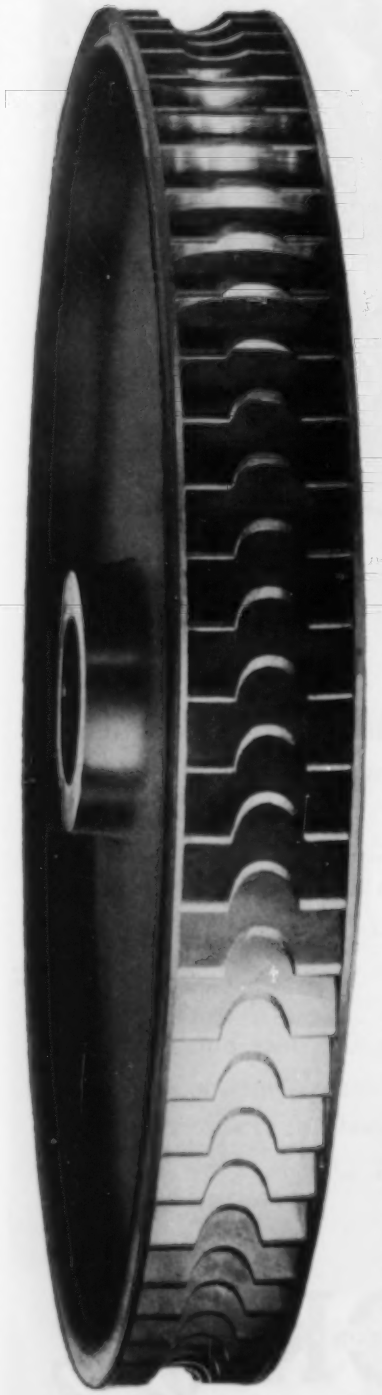
It will pay you to have Cook make a "job-engineered" survey of your ring requirements. There's no obligation.

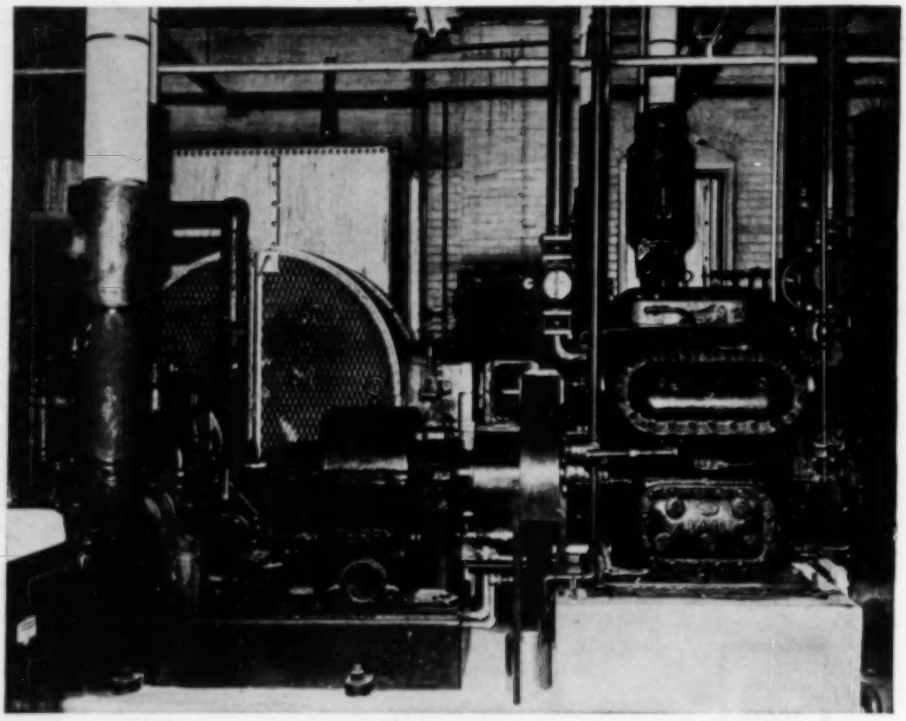
C. Lee Cook Mfg. Co., Incorporated, Louisville, Kentucky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK GRAPHITIC IRON
PISTON RINGS

. . . SEALING PRESSURES SINCE 1888 . . .

the Terry Turbine





Refrigeration Compressor Driven By Terry Turbine

AT HAMPDEN BREWERY

This 150 hp Terry Turbine — at the Willimansett, Mass. plant of the Hampden Brewing Co. — operates at 3800 rpm with a gear reducing it to 720 rpm. It is coupled to a 6 cylinder reciprocating compressor.

The installation is running on steam conditions of 120 psi — 0° superheat, and the steam to the turbine is automatically throttled to maintain a constant 30 psi back pressure for process and heating. The installation was developed by Fred Ophuls & Associates Consulting Engineers.

Get more information on the wide range line of Terry Turbines from your local District Representative. There's no obligation for a complete discussion of your specific requirements. Also send for Bulletin S-143 that gives full details.

THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

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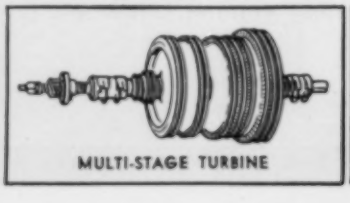
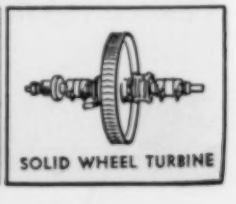


MULTI-STAGE TURBINE



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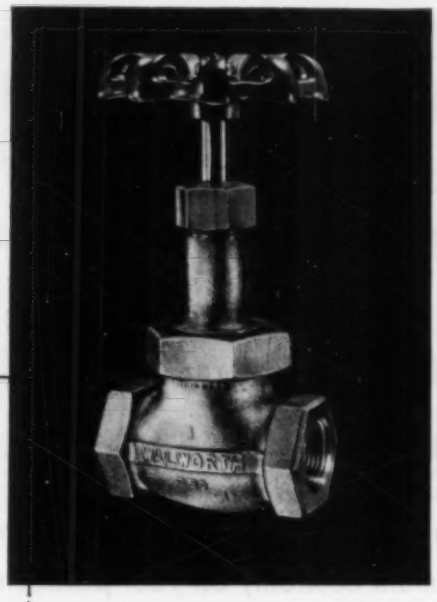

take a good look at the Walworth "500 Brinell" no. 225P Globe

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– the Toughest Bronze Valve Your Money Can Buy

The stainless steel, corrosion resistant seats and discs are heat treated to a hardness of 500 Brinell – hard enough to scratch glass and crush nails! The valve can be closed on sand, slag, and pipe scale without injury to the seating surfaces. "Wire drawing" is practically eliminated. All parts are accurately machined and gaged. Years of tight, positive shut-off are assured.

Available in both globe and angle types (angle type: No. 227 P) in sizes ¼" to 2", this quality valve is recommended for 350 lbs. W.S.P. at 550 F, and 1000 lbs. non-shock service on cold water, oil, gas, or air.

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ON THE COVER

SIXTH largest suspension bridge ever to be built, the 3½-mile-long Delaware River Memorial Bridge with a center span of 2150 feet, is taking form near Wilmington, Del. A 4-lane vehicular structure, it will cross the river to link the New Jersey Turnpike with the du Pont Highway. Our cover picture was taken some months ago and shows a feature of the work that motorists traveling the bridge will never see. To establish a foundation for the west-anchorage pier, an open-well caisson, 221 feet long and 95 feet wide, was sunk to bedrock by Merritt-Chapman & Scott Corporation, contractor for the substructures. Four revolving-type derricks may be seen dredging material through circular wells. Also visible are 30-foot-diameter cylindrical "sand islands," one at each corner, to hold the caisson in position during the early stage of the sinking operations. Deepwater Point, N.J., is in the background.

•

IN THIS ISSUE

FLOATING bucket-line gold dredges perform on a gargantuan scale essentially the same operations that were carried out by the hand-placer miners who played a great part in nurturing the West's mineral industry. The Natomas dredge in Copper Canyon, Nev., which is described in our leading article, digs as deep as 85 feet below pond level and delivers 10,000 cubic yards of gravel a day to a gold-recovery plant on board. The dredge is operated with electric power generated by a separate land-based plant that could supply the needs of 500 families.

•

TO KEEP pace with the power requirements of a mushrooming population in the territory it serves, the Southern California Edison Company is spending $25,000,000 to increase its generating capacity. A major project of the program is the Big Creek No. 4 hydroelectric development on the San Joaquin River. The article that starts on page 237 describes the driving of a 2-mile tunnel essential to the operation of the plant.

•

IN A NEW mill near Antioch, Calif., Fibreboard Products Inc., turns out daily 1000 tons of paperboard to help meet the huge demand for cartons and containers. A novel feature is the use of an air compressor as a brake for a heavy log-chipping wheel. Page 242.

Compressed Air Magazine

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Panning Gold with 1500 Horsepower

Giant Floating Dredge Scoops Up 10,000 Cubic Yards of Gravel Daily and Extracts Golden Flecks from It

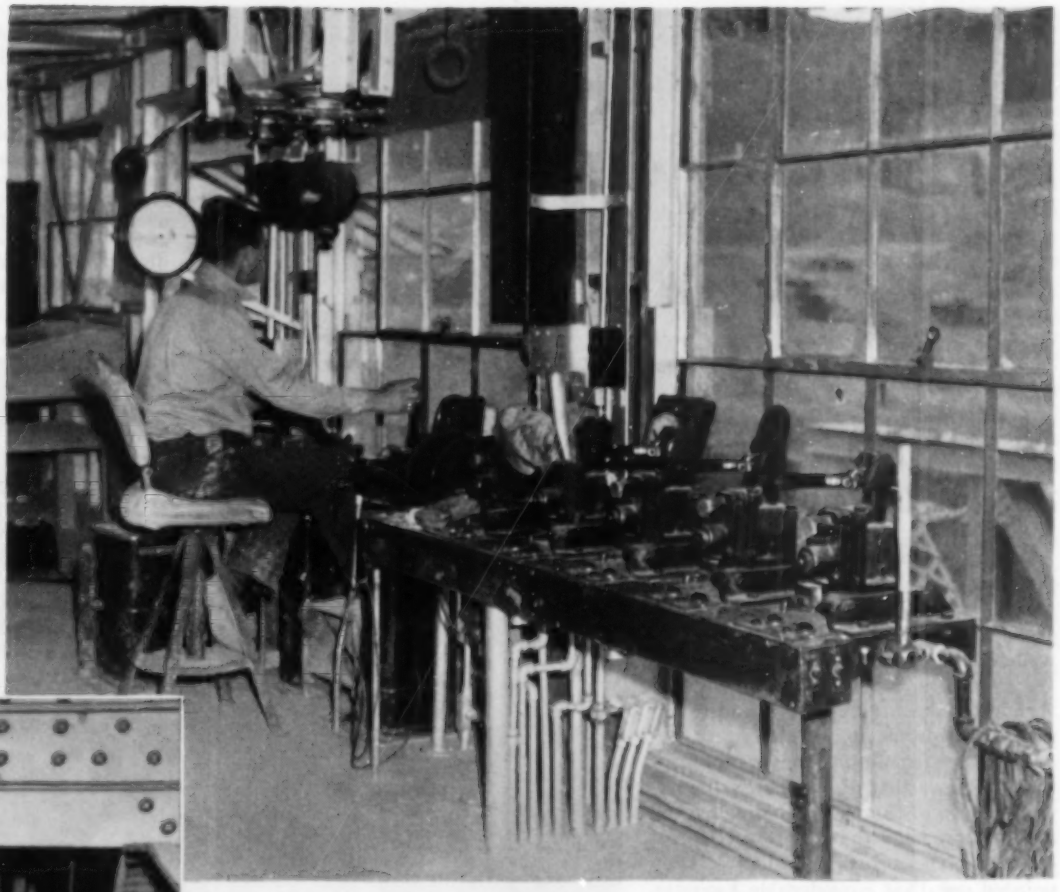
L. A. Luther

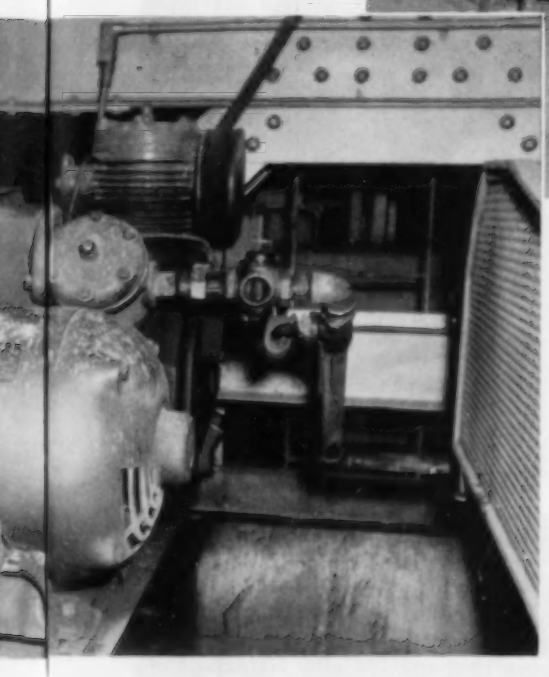
NEIGHBORS of old Father Noah, watching his ark of well-pitched gopherwood rising on dry land, might have thought his judgment immature, but no one passing a shipbuilding job about a year ago in high, dry Copper Canyon, some 18 miles south of Battle Mountain, Nev., paused to debate the sanity of the builders. For they were busy assembling a 76x177-foot hull from steel pontoons 10 feet deep and providing it with digging and washing equipment for the recovery of proven gold values from an alluvial fan at the canyon's mouth.

Huge dredges of this kind have become fairly common sights in our western states and represent a heavy capital outlay. Their evolution has been a gradual one and might be said to stem from man's earliest efforts to extract precious metals from so-called placer deposits. One has only to engage in a little laborious "hand placering" with shovel and pan to understand why man, through

SHIP IN THE DESERT

The dredge is pictured at the top-center with a stormy sunset in the background. Its digging end is at the left and its waste stackers at the right. The view at the left-center shows the bucket line, partially submerged and digging at shallow depth. Discernible in the distance, between the dual 185-foot-long tailings stackers seen directly above, are the buildings of the Copper Canyon Mining Company.





THE PILOT AT HIS POST

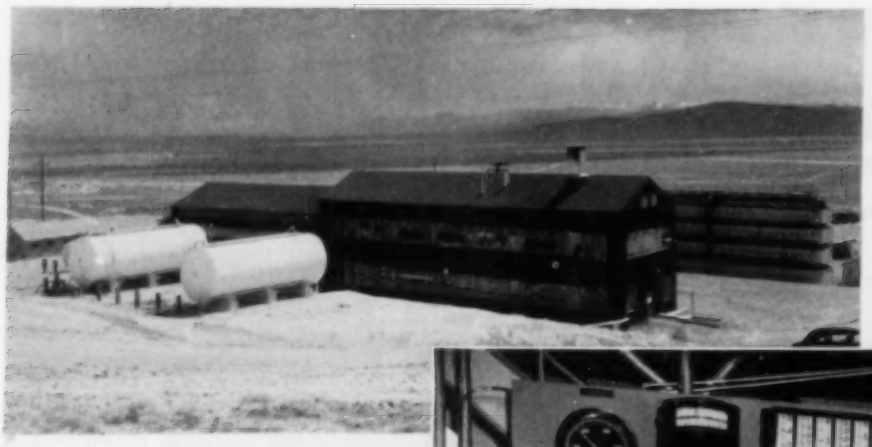
Like the bridge of a ship, the winchroom of the dredge (above) is the nerve center of operations. There the winchman sits, high up, looking down the string of buckets and swings the forward end from side to side, meanwhile directing the digging. At his finger tips are air-electric controls that telegraph his messages to motors, clutches, and brakes. Somewhere below deck is a small, motor-driven air compressor (left) that provides fluid power instantaneously to transmit the actuating impulses.

the centuries, has dreamed of creating a machine that could dig and pan more ground than an army of slaves.

Means now used to recover gold from alluvium are largely refinements of geologic processes that tend to concentrate nuggets and dust to form rich deposits such as those worked by California's forty-niners. The fact that gold has seven times the specific gravity of quartz, and that immersion in water increases the differential to eleven times, are indications of water's erosive and washing action in gold-bearing rock in its native state, as well as of its usefulness as a lubricant and catalyst in miners' gold pans and more elaborate apparatus.

Placering was first carried out by paleolithic man when he searched river beds for flints from which to fashion stone implements. The earliest records we have of placer gold mining are Egyptian hieroglyphics from 3400 B.C. In the archives of the University of Turin, Italy, is the world's oldest-known map. Dating back to 1300 B.C. it portrays, among other things, "mountains in which gold is washed." Gaius Plinius Secundus, appointed procurator of Spain in 66 A.D., wrote a detailed account of the booming and sluicing of placer ground practiced by the Romans in Spain before the Christian Era. In a translation of Georgius Agricola's 1556 Latin treatise on mining, made by Herbert Clark Hoover and his wife Lou Henry, any student can read descriptions of ancient pans, rockers, and sluices, and of such materials as cloth, turf, and woven horsehair employed in trapping raw gold. The legend of Jason and his Golden Fleece seems to have had its origin in an expedition that set out to loot placer workings in which fleece was used to catch and hold the yellow metal much as riffles, matting, and burlap were utilized later.

Placering is a somewhat loose term for any means of gold recovery more elaborate than hand pan or rocker, and dry placering refers to any concentrating method without the use of water. Nevada, because of its extreme aridity, encouraged the development of the latter, employing power machines of some complexity. Placering in its truest sense—an operation in which water under pressure is directed against alluvial banks with nozzles or monitors—was introduced in California in 1850, and by 1876 one hundred million dollars had been invested in enterprises of that kind. The rapidity with which the Sierra alluvium was being washed down into California valleys brought court action which culminated in the creation of the California Debris Commission to regulate mining practice. In Nevada, placering is said to have begun under the Mexican regime prior to 1848. Considerably later, men placering for gold in blue-clay alluvium in Six Mile Creek at a point near Virginia City found that the recovered material was rich in silver values, thus initiating activities on the fabulous Com-



POWER PLANT ON SHORE

Because it operates 200 miles from the nearest sizable central generating station, the dredge gets current from its own oil-burning powerhouse pictured at the left with fuel tanks in the foreground and cooling tower beyond it. The instrument panel for its 350-pound pressure boiler is shown below.

stock Lode—the first notable silver-mining district in the United States.

Alluvial deposits being worked at Copper Canyon by Dredge No. 2 of the Natomas Company, a project designated as the Greenan Placers Operation, serve well to illustrate how Nature, through the centuries, washes gold downward through broken and porous strata to impervious bedrock or clay. Writers, describing the formation many years prior to Natomas's tenure, estimated the average depth of the placer channels at 50 feet and reported that the lower 15 feet contained the principal values. They pointed out that considerable limonite, quartz, and pyrite was attached to the gold, indicating that it was fairly close to its source. There were boulders of copper ore in the channels, showing that the precious metal was derived from copper-gold bearing veins in rock formations a short distance above.

In 1931, a nugget worth $150 was found, but most of the gold produced earlier was relatively small and angular in shape with sharp corners, again indicating little scouring en route—that it had not traveled far. Extensive lode-mining operations are in progress up the canyon by the Copper Canyon Mining Company, the headframe of the main shaft being about ¼ mile from the site on which the dredge was assembled. Though its mining and milling setup is primarily engaged in producing metals other than gold, some of the latter is being recovered.

Discovery of placer gold in Copper Canyon was made by James Dahl, a veteran of the Klondike rush who was associated with a Mr. Christensen of Battle Mountain. As was doubtless typical of many such properties, the apparatus used to work the deposits gradually increased in size and complexity up to the erection of the huge bucket dredge in 1949. Dahl and Christensen soon had 90 men mining the channels by aid of drifts and hand rockers. The placer was subsequently taken over by Good, Kenneberg & Wilson, who set up a dragline and sluice and piped water for washing from nearby Willow Creek. About 1930 it was acquired by Dudley Wilson, a member of the predecessors, who drove a 2300-foot access tunnel and mined by drifting on bedrock. Gravel was hand trammed to the surface and unloaded in a series of bins on an elevated trestle, from which it was fed into several hundred feet of 16x12-inch sluice equipped with T-rail riffles. A 200,000-gallon tank built at the end of a 3-mile pipe line supplied the necessary water.

In 1935 the property, comprising 26 claims of 20 acres each, was taken over by the Grand Hills Mining Company, a firm representing Oklahoma City capital. This operator systematically removed 35 feet of overburden containing low values and wasted it, using a power shovel and dump trucks. The underlying material to bedrock, which averaged $1.50 per cubic yard according to writers on Nevada mining, was handled by similar means, the trucks dumping it onto a conveyor serving a 22x6-foot steel trommel turning at the rate of 9 rpm. It was equipped with bars to pulverize cemented material, with a set of graduated screens, and with a spray pipe carrying water under pressure, the treatment differing little from that to which the material is now subjected in much larger revolving cylinders on modern bucket-line dredges.

After coarse rock had been eliminated by the Grand Hills trommel, fines were split into four streams. Each was fed to an Ainlay centrifugal gold separator, essentially a 36-inch steel bowl rotating at 91 rpm., which tended to throw the coarse material up and over the sides while the gold was caught on peripheral riffles inside. Some 90 percent of the values was thus recovered and 10 percent on riffles in a 40-foot tailings sluice. During 1946 and 1947 the Natomas Company operated a dragline-type dredge, equipped with a 3½-cubic-yard bucket, in the narrow and steep part of Copper Canyon and extracted the gold with a floating diesel-powered washing plant.

The first true bucket-line dredge in the West was used in the Yuba River near Marysville in 1850, and in 1897 a New Zealand type of better design was at work in the Feather near Oroville. The development of bigger, improved designs to meet California's requirements was begun soon after the turn of the century by predecessors of the Yuba Manufacturing Company, now the world's largest dredge builder, with offices in San Francisco. While some units operate in streams, the initial task of most dredgemen is that of scooping out a pond on

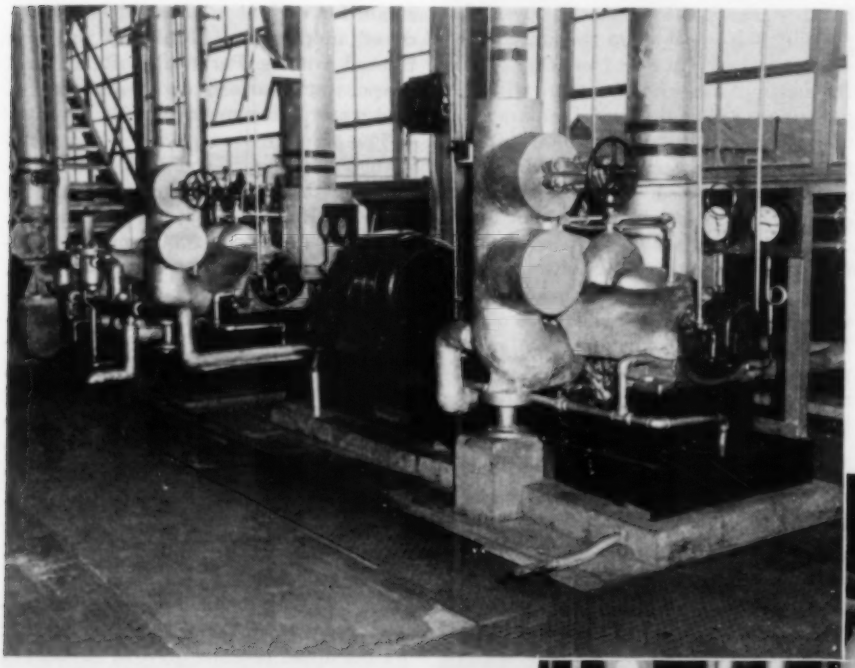
which to float their craft, as was the case at Copper Canyon. The great volume of water needed for that purpose and to serve the washing apparatus is drawn from lakes, streams, or wells, and is often carried long distances in a pipe line or sluice. At the canyon, an ample supply was obtained by driving a 16-inch well to a depth of 400 feet in a dry lake some 2½ miles from the dredging site.

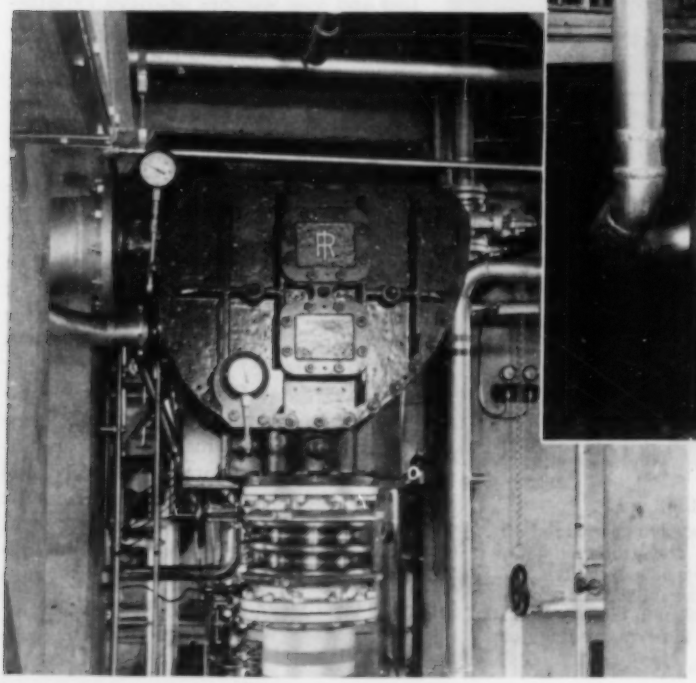
The real navigator of these great steel barges, some of which displace 3750 tons, is an engineer who does not have to be aboard. The craft are relatively seaworthy, for they have been towed in various stages of completion across the Gulf of Mexico and then several hundred miles up a river to working areas in Colombia. Four sizable, specially sectionalized dredges designed by the Natomas Company were transported entirely by aircraft to placer deposits in the hinterland of New Guinea.

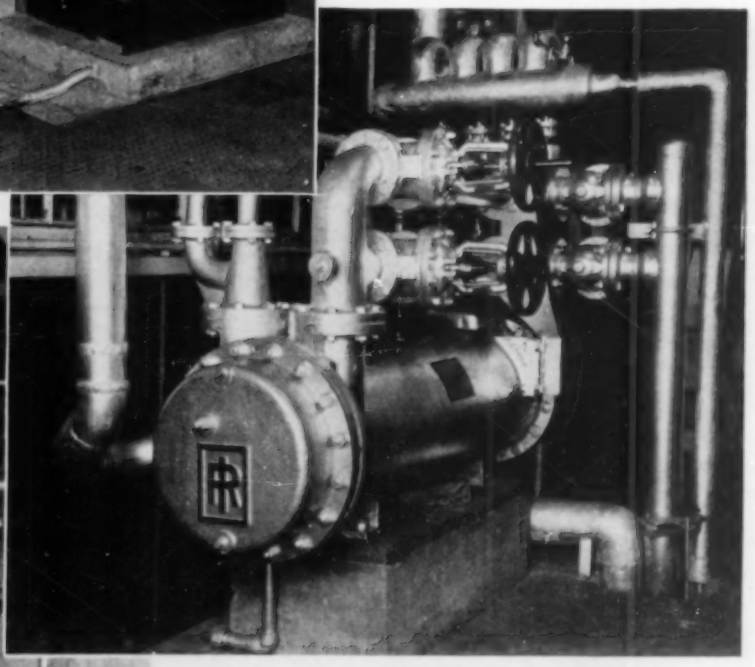
Hulls have a central well hole in the forward end to accommodate the massive box-girder type digging ladder around which the bucket line is driven on rollers by a tumbler at the upper end. The Natomas dredge at Copper Canyon has dual direct-current motors at each end of this tumbler, the power developed being transmitted through massive reduction gearing. As much as 600 hp. is sometimes required to drive a bucket line. Digging ladders on big, deep-dredging units are up to 216 feet long and carry buckets with a maximum capacity of 18 cubic feet controlled by guides and cables operated by hoisting winches. A 216-foot ladder can excavate 124 feet below pond level, or 174 feet below ground level, allowing for a 50-foot bank.

Dredges are moored by means of a cable-controlled spud near the stern that is forced into the bottom of the pond, the forward and working end of the barge pivoting on this leg. Usually the maximum ladder angle is 45 degrees, and the craft is maneuvered back and forth by port and starboard bowlines one end of each of which is secured to the digging end of the ladder. From there it is passed through a block anchored ashore, through another sheave at the bow of the dredge, and then back to one of two huge swinging winches.

Most dramatic, though sometimes monotonous, is the job of winchman. While the dredgemaster's role is that of captain, so to speak, the winchman is the man who keeps the barge swinging and digs the paydirt as he sits looking down the ascending line of massive buckets. Flanked by telephone and air-electric controls reaching every principal motor, clutch, and brake, his winchroom corresponds roughly to the bridge of a ship. Absence of navigational hazards doesn't confine placering to dull routine, for sometimes a bucket line is lost in 100 feet of muddy water, and the difficulties of replacing it can well be imagined.







POWER-PLANT AUXILIARIES

Steam that spins the 2500-kw. turbine is condensed in an Ingersoll-Rand condenser (left) by water cooled in the 2000-gpm. Fluor natural-draft tower pictured on the preceding page. Air is removed from the condenser by the ejector illustrated above. Water is supplied to the boiler by either of two 5-stage I-R centrifugal pumps (top picture) each rated at 75-gpm. capacity. The near one is turbine-driven and its companion is motor-driven.

Dredges have been used to dig for platinum ores in Russia and Alaska, in mining placer tin, and in the recovery of sapphires and garnets. Preparatory stripping operations and dredging have turned up odd mementos of past generations ranging from refrigerated carcasses of mammoth elephants in Alaskan tundra to Inca fishhooks of 24-carat gold. Up to date, Natomas has uncovered nothing of historic or scientific interest save rails, mine cars, and other equipment used by its predecessors. The material so far excavated is reported to be extremely hard and abrasive, with very ragged and unpredictable contact with bedrock and with many large boulders to complicate operations.

The unit now at work in Copper Canyon was rebuilt by Natomas's Gold Dredging Department and is designated as No. 2. It was first used at Manhattan, Nev., from 1939 to 1947, and was modified to provide a longer digging ladder for Copper Canyon. It is known as a 9½-foot dredge, which indicates the cubic contents of the buckets, of which there are 120 on a 162-foot ladder. Operations at the present site began on September 1, 1949, after some preliminary stripping of overburden had been done with a bulldozer and dragline. The dredge digs to a maximum depth of 85 feet and at the rate of 10,000 cubic yards per 3-shift day. The number of workers totals 39, many having families and living in houses provided at the site.

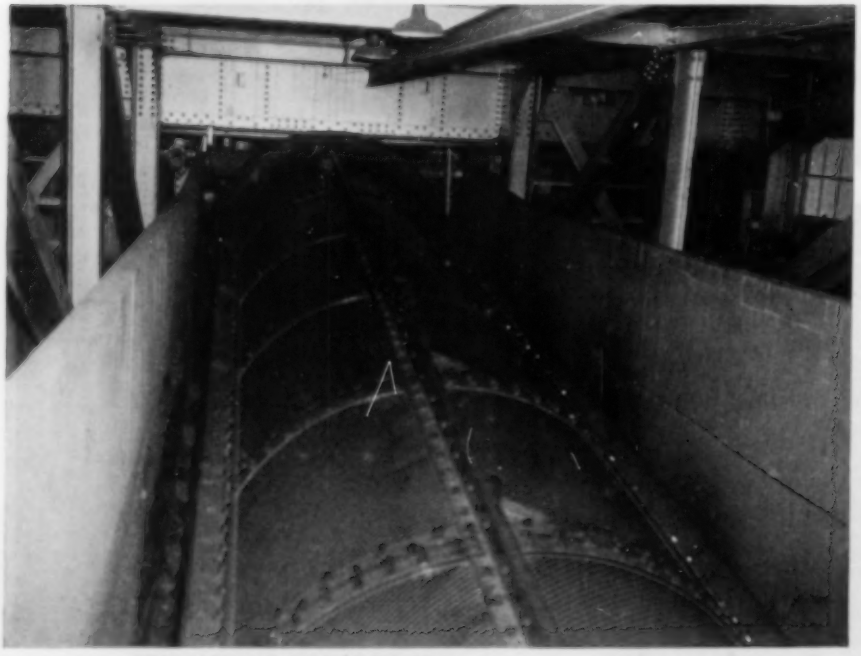
The buckets discharge into the upper end of a revolving inclined trommel, 8 feet in diameter and 48 feet long, provided with a series of high-pressure water jets for thoroughly washing fines from rock. The rejected coarse material is dumped into the pond or fed to twin 185-foot-long stackers. Gold-bearing fines first go to two banks of Pan American jigs whose pulsations and screens carrying steel shot hasten separation. Next they pass over banks of inclined riffles, where the concentrate is picked up by a bucket elevator and carried to a cleaner jig. From the latter, coarse material of sufficient specific gravity is fed to a ball mill for further separation and thence over a riffled discharge sluice. The reject from the recovery processes may be either dumped onto the pond bottom or fed to stackers, the choice of disposal depending somewhat upon the stability of the banks being dug and whether or not the accumulations will interfere with the movement of the dredge. Cleanup day, once a week, is the most arduous of any, for then the concentrates and amalgam must be collected from every riffle, cleaned, and retorted, and the shut-down dredge becomes a hive of repair, replacement, and adjustment activities.

The 1500 horsepower represented by the multiplicity of electric drives on the Natomas No. 2 Dredge is typical of the problems besetting builders of equipment of this type for work at remote locations. In this instance, it would have been necessary to construct a 200-mile transmission line from Reno, but even there the utility serving the area was unable to supply essential current. Natomas therefore decided to create something of an innovation in dredging practice by erecting, at the site, a model power plant with a capacity sufficient to serve the needs of 500 to 700 families. A high-pressure boiler burning low-grade residual bunker oil supplies steam to a turbine-driven generator. Fuel, consumed at the rate of about 3350 gallons each 24 hours, is hauled from Salt Lake City in 5950-gallon truck-and-trailer tanks and stored in two 21,000-gallon tanks. The Puget Sound boiler has a capacity of 30,000 pounds of steam per hour and operates at 350 pounds pressure and 750 degrees superheat. Some steam for various auxiliary drives is reduced in pressure. Make-up water is treated with a Permutit softener and evaporator, thirteen or so analyses of feed water being made each 24 hours.

The plant produces 4160-volt current with a 2500-kw. General Electric condensing turbine served by a single-pass Ingersoll-Rand condenser provided with cooling water by a 2000-gpm. natural-draft Fluor tower. Condensate and boiler-feed water are handled by Cameron pumps. Current for use during shut-down periods, for starting the plant, for lighting, and for general repair work is furnished by two 75-kw. high-speed diesel-electric generating units. A Type 30 compressor supplies air for Bailey controls used throughout the plant. One end of the building is occupied by a repair shop served by an overhead crane and equipped with essential machine and pneumatic tools.

The 600-hp., 4160-volt motor-generator set which furnishes direct current for the upper tumbler drive of the bucket line and bow winches provides variable-speed control. The ladder hoist is powered by a 250-hp. motor which, together with several other drivers, uses 440-volt alternating current, while both the dredge and shop have 110-volt circuits for lighting and general utility. Heat aboard the craft is supplied by a low-pressure boiler supplemented by electric units at numerous points, the twin 185-foot tailings stackers being heated with Cal-Rod installations which make it practicable to work in winter at the very low temperatures prevailing at the 5200-foot altitude.

The Greenan Placers Operation is under the supervision of R. G. Smith, president and general manager of the Natomas Company, with C. E. McKay in direct charge as resident manager at Copper Canyon and the following staff: William Bottini, engineer; George Guiler, dredgemaster; H. B. Prince, office manager; G. B. Blake, chief engineer of the powerhouse; and J. V. McClure, chief electrician.



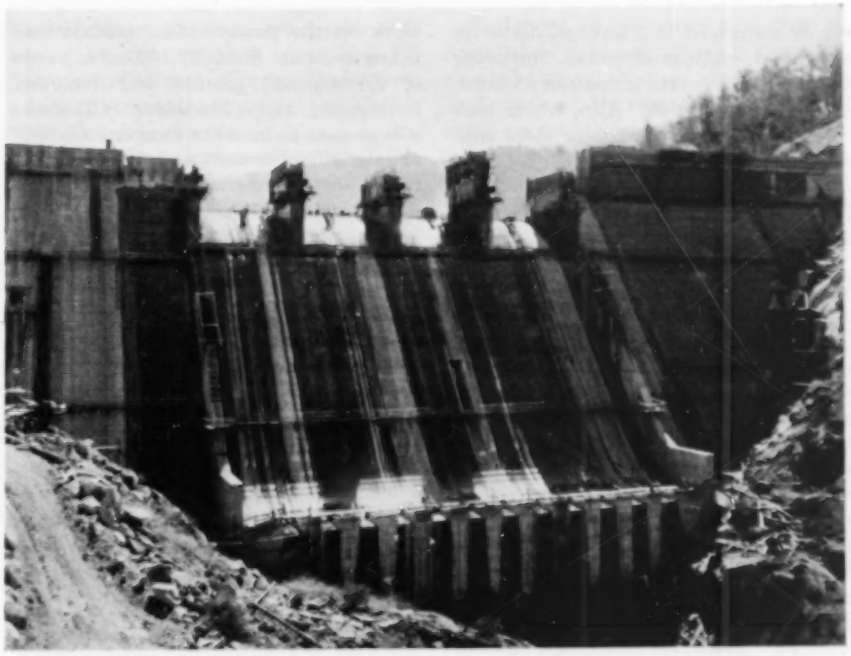
STARTING POINT OF GOLD RECOVERY

Gravel scooped up by the bucket chain is dumped into a revolving, inclined circular screen or trommel 8 feet in diameter and 48 feet long. There the gold-carrying fine material is washed from the rock by high-pressure jets of water and is then passed through jigs and over riffled tables to winnow out the metal. The coarse material discharged from the trommel goes overboard back into the pond or is carried aft to spoil banks by the stackers. The picture shows the exterior of the big trommel.

Tunnels for Power

Fast Driving of Large Bores Marks Work on Big Creek No. 4 Project of Southern California Edison Company

David W. Lutes*



DOWNSTREAM FACE OF DAM

The gravity-type structure rises approximately 240 feet above bedrock, is 850 feet long at the crest, and contains about 240,000 cubic yards of concrete. Water may be seen passing over the spillway which, when completed, will be equipped with four 20x40-foot radial gates to control the flow.

IT IS a known fact that there has been an ever-increasing movement of people and of industry to the Pacific Coast in recent years. This was enormously accelerated during the war when shipyards, aircraft factories, and countless other plants drew hundreds of thousands of workmen and their families from all parts of the country. Huge military and naval bases brought additional thousands to California, Oregon, and Washington. Although the entire West Coast has been affected, the greatest changes occurred in Southern California where many cities and towns mushroomed to two and three times their prewar size.

The significant aspect of this is that, following hostilities, the population has not appreciably diminished, as might have been expected, and production has continued apace. As a result, facilities of private- and public-utility companies have been sorely taxed to supply the demand for water and power for domestic and industrial use. In an effort to meet requirements, the Southern California Edison Company—major producer of electric power in Southern California—has undertaken a 250-million-dollar postwar construction program. One feature of it is Big Creek Project No. 4, which is located in the foothills of the Sierra Nevada Mountains and on the San Joaquin River approximately 55 miles northeast of Fresno. This project includes a concrete gravity-type dam 248 feet high and containing some 240,000 cubic yards of concrete, better than 2 miles of tunnels, penstocks, and a powerhouse.

*Job Engineer for Bechtel-Morrison-Knudsen Company, (joint contractors).

Since the sole purpose of the scheme is power development, the principal factor was to realize the maximum hydrostatic head economically practicable. Engineering studies indicated that this could be accomplished by limiting the height of the dam and utilizing the natural fall of the river bed to gain additional head. Hence, it was decided to raise the level of the water in the river by approximately 210 feet by means of a dam, and to obtain another 210 feet by locating the power plant about 2 miles downstream, thus making available a static head of 420 feet.

PROFILE OF TUNNEL LINE

From the dam, which will raise the level of the river 210 feet, water will flow some 2 miles downstream through tunnel and conduit to a powerhouse that will operate under a static head of 420 feet. Most of the tunneling was done from the Willow Creek portals.

To get water from the reservoir behind the dam to the powerhouse, the plans call for a 24-foot horseshoe tunnel having a length of 10,508 feet and extending through two mountains, separated by a creek, to a point (elevation) 240 feet above the plant. Thence a 15-foot-diameter steel penstock, branching into two 10½-foot pipes, will deliver it to the turbines below. From the intake structure of the dam a 17-foot-diameter steel conduit will convey the water to the upper end of Section No. 1—the shorter of the two—which is 2400 feet long and drops on a 20-percent slope for a distance of 200 feet before leveling out to a 0.003 gradient. Next, a 15½-foot-diameter steel pipe, supported by ring girders, will carry the water a distance of 569 feet across Willow Creek to the upper portal of Section No. 2, which will be 8108 feet long.

Both tunnels will be unlined, except for a short section at each portal which

will be concreted to a finished diameter of 17 feet. These stretches, including four 25-foot concrete transition sections, total 1174 lineal feet. Also, where rock conditions require timber or steel supports, plans specify lining with concrete to a finished 19-foot horseshoe section. The invert will be paved with 6 inches of concrete.

To make this project a reality, the Southern California Edison Company entered into a contract with Bechtel Corporation and with Morrison-Knudsen Company, Inc., for the engineering design and construction of the dam, tunnels, and powerhouse. Building of the dam and tunnels is being sponsored by Morrison-Knudsen, with H. L. Leventon as construction manager. Mr. Leventon, who has had broad experience in directing projects such as the Navy's vast underground fuel-storage facilities at Red Hill, Honolulu, is assisted by Carl J. Herslof, general superintendent of tunnels, and John L. Armitage, general superintendent of the dam, men of equally wide experience. Management of the Bechtel-Morrison-Knudsen joint venture is headed by J. R. Kiely of Bechtel Corporation.

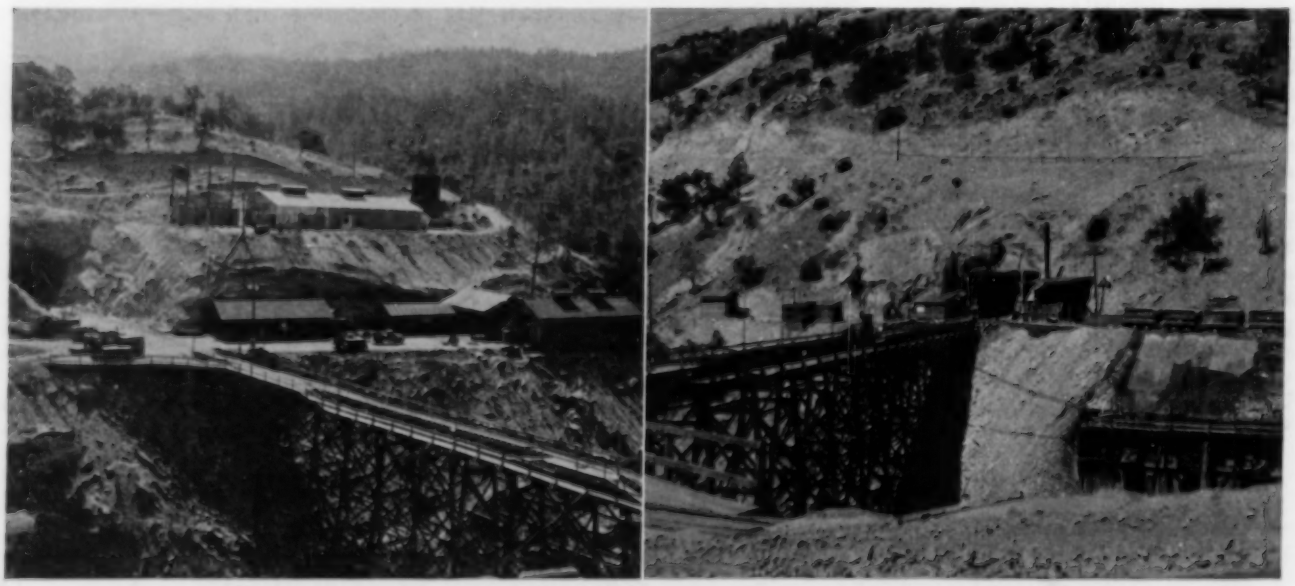
Work on the dam was begun in June, 1949, with the building of temporary roads, establishment of a camp to house and feed 280 men, and erection of a plant essential for an undertaking of this magnitude. Driving of the power tunnels was not started until after the completion of the temporary diversion tunnel—a 23-foot horseshoe-shaped bore 855 feet long—beneath the right abutment of the dam. While that tunnel was underway, work on the power-tunnel portals was taken in hand. Some 27,100 cubic yards of decomposed granite was removed by blasting, and a Northwest 80D shovel was used to load the loosened material into 10-cubic-yard end-dump Euclid trucks for haulage to disposal. Concurrently, the erection of buildings and the grading and laying of track for muck trains were being rushed so that all would be in readiness for the shift in operations from the diversion tunnel to the power tunnels.

The program called for driving the two tunnels from the Willow Creek portals so that a central plant would serve both headings. Since this project is situated in a National Forest, the United States Forest Service had to sanction all spoil areas. The only one that met with its approval was a narrow strip extending from Tunnel No. 1 Portal 500 feet upstream along the east bank of Willow Creek. As the west side offered the only place for an access road, it was necessary to locate the shop buildings adjacent to the downstream portal of Tunnel No. 1.

By benching into the mountainside, it was possible to provide a space level enough for the erection of a blacksmith shop, a repair shop, tool sheds, and a battery house, with a 25x75-foot change house, a small powder house (for temporary storage only), and a make-up house nearby. Included in the shop equipment are an Ingersoll-Rand No. 54 drill sharpener, a thermostatically controlled oil-burning furnace, an air-operated cutting wheel, a Toledo threading machine for drill rods, an electric grinder for bits, and three 50-kw. motor-generator sets for charging batteries. A job-built gantry crane, with an electric-powered hoist and an air hoist for travel, was installed in the battery house to facilitate handling the 5-ton batteries between the locomotives and the charging stands.

Another bench, roughly 60x150 feet, was excavated some 40 feet above the site of the shop buildings for a transformer yard and a compressor plant. Housed in the latter are seven stationary units, with a total capacity of 7000 cfm., which serve not only the tunnels but also the rock quarry and for dam construction. One of the machines, a 1000-cfm. Ingersoll-Rand Type 10-B, was brought down from Huntington Lake where it had been used on the Big Creek-San Joaquin power-development system. Upon request, the company provided foundation plans for this compressor so that work on the footings could proceed prior to its arrival. It was interesting to note that the blueprint furnished was a copy of the original installation plan dated 1912.

Water for the tunneling operations is obtained from a 500,000-gallon reservoir centrally located so as to serve the entire project. It is supplied by two 750-gpm., 450-foot-head, 2-stage opposed impeller pumps stationed ¼ mile above the dam. Because of the extreme rise and fall of the river during flood periods the pumps are mounted on a barge made up of three Army-surplus, 25-person Weber life rafts and are connected to the reservoir's 8-inch supply line by a 40-foot section of 8-inch rubber hose with flanged couplings.



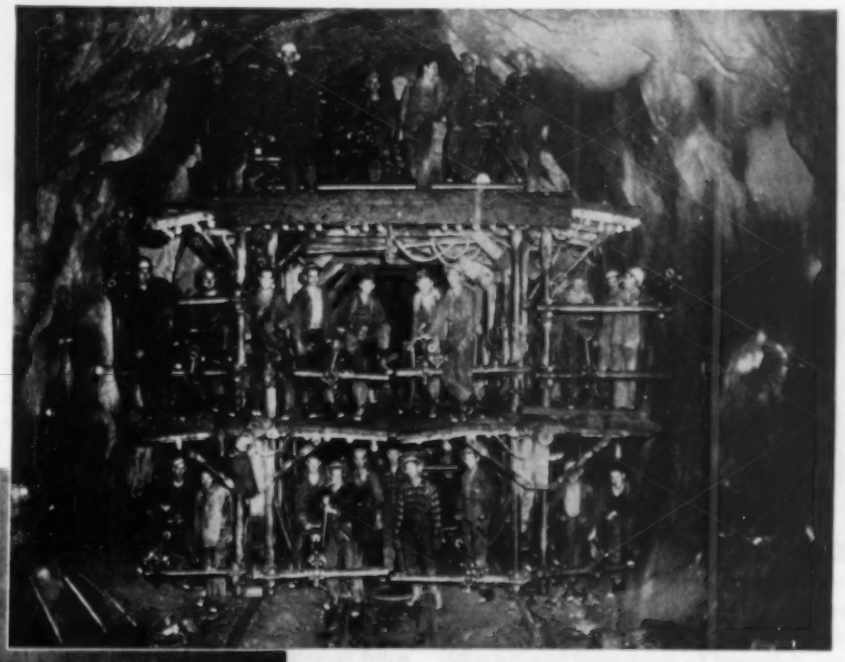
WILLOW CREEK PORTALS

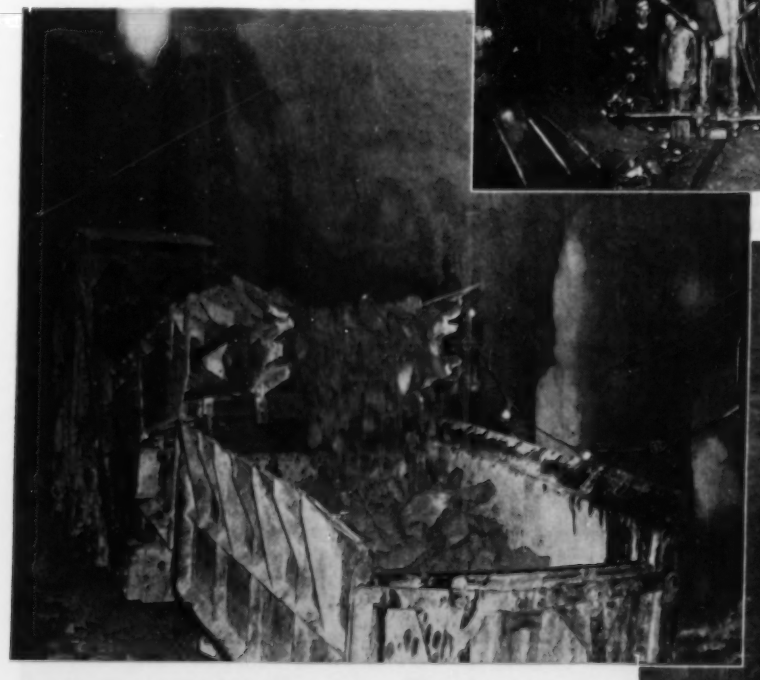
The picture at the left shows the outlet portal of Tunnel No. 1 at the extreme left and part of the Willow Creek trestle in the foreground. Two benches were excavated in the hillside to provide level spaces for buildings. On the upper level are power transformers, the compressor house, and a tank for compressor cooling water. Shops for blacksmithing, general repairs, and bit sharpening, a storage building, and a battery house are on the lower level. The inlet portal of Tunnel No. 2 is pictured at the right. At the lower right is a bulkhead that was erected for loading tunnel muck into 10-cubic-yard end-dump trucks for haulage to the concrete-aggregate processing plant.

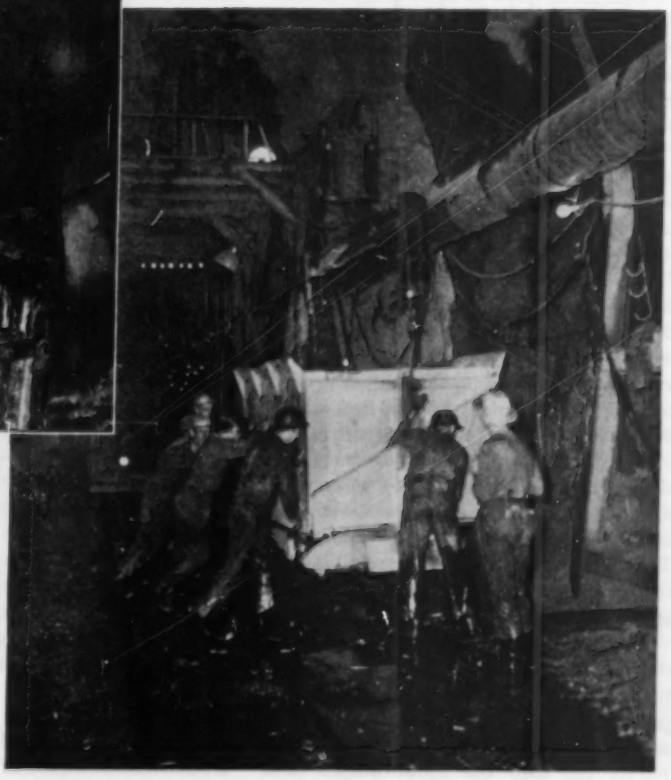
Actual driving of the power tunnels was started on September 22, 1949, when the contractor holed-in at the lower end of Tunnel No. 1. By the twenty-fourth, the working face had been advanced 20 feet and timbering at the portal and of 14 feet of that stretch had been finished. From that point on the rock, semihard granite, was sound until the heading had progressed 1800 feet. Then the condition of the formation was such as to again necessitate timbering for a distance of 42 feet. Twelve sets of timbers were installed. No further support was needed in this bore. Advance was steady, with crews working three shifts per day, six days a week. What is believed to be a record for tunnels of this size in hard rock was set during the 6-day week preceding December 3, when 222 feet was completed. This represents an average of 37 feet per day, or the removal of 730 cubic yards. The best daily progress during that week was 41 feet.

Equipment used in Tunnel No. 1 included a drill jumbo with double-flanged 2-wheel car trucks for 10½-foot-gauge track. Mounted on it in three stages are thirteen 3½-inch Ingersoll-Rand Model DA-35 drifter drills using 4-foot change 1¼-inch steel and 2-inch I-R Carset bits. The rounds averaged 94 holes each and were ordinarily drilled to a depth of 12 feet, pulling 10 feet of rock. Excavated material was handled by a 100-hp. Model 75-B Conway mucker loading into 6-cubic-yard Western dump cars made up in trains of five each and hauled by 10-ton Goodman battery locomotives. Three, and sometimes four, locomotives were in service in each heading—two pulling muck trains and one man-cars, drill-steel cars, powder cars, and for other general uses.

Switching of the muck cars was accomplished by a mechanism powered by an air hoist mounted at the rear of the drill carriage. By means of this arrangement an empty was lifted high enough to permit the train to pass underneath. Then the car was lowered, guided on to the rails, and pushed by the train to the mucker. An empty was always left there while the loaded train departed for the dump and a string of empties, waiting on a switch a short distance back of the jumbo, was moved up. Fresh air was







SCENES IN TUNNEL

The drill carriage used in Tunnel No. 1 (upper-right) was equipped with thirteen Ingersoll-Rand DA-35 drifters having 48-inch aluminum sliding cone shells and centralizers to aid in starting holes. Drilling was done with 2-inch Carset bits on 1¼-inch rods. The view above shows the 100-hp. Conway mucking machine used for loading blasted material into cars. The empty in the picture at right is being shifted by a "cherry picker" in Tunnel No. 2. An air cylinder, suspended from a boom at the rear of the drill carriage, has lifted it so that it can be pushed aside to allow a muck train coming from the working face to pass by. The car was then shifted back to the track to become the lead car of the next train to be pushed up to the heading.

PREPARATIONS FOR CONCRETING TUNNELS

Circular steel forms mounted on a jumbo in Tunnel No. 1 are shown at the right. Pictured below is the rig for shooting concrete into place with air-operated Hackley guns. All told, 1174 linear feet of tunnel adjacent to the portals and certain additional stretches where unsound rock was encountered will be lined.

supplied by a 12,000-cfm. Root-Connersville blower located at the portal and was delivered to the tunnel face by a 22-inch-diameter pipe of light-gauge metal.

On November 7, while the heading was being driven from the west portal, work was begun at the east end on an 8x8-foot drift extending down the 20-percent slope for a distance of 213 feet. This drift was completed on December 3, and was then ring-drilled to the average tunnel section but not blasted until after the opposing heading had reached it and been holed through on December 23. When operations were resumed after the Christmas holidays the drift was blasted out and the loose rock loaded into cars by the mucker stationed at the toe of the rise, a slusher being used to drag the material down to that point. While work on Tunnel No. 1 continued, a temporary timber trestle was constructed across Willow Creek to provide muck trains and equipment with a means of access to the upper portal of Tunnel No. 2. The structure will be put to further use later when the 15½-foot steel pipe line is laid between the tunnels.

Getting underground at the upstream entrance of Tunnel No. 2 presented a problem because the main road to the project crossed at a point less than 80 feet above the portal. There the road is partly cut into the mountainside and partly supported on fill. First, loose material was removed back to a reasonably solid face; then the entire slope on each side of the tunnel center line was gunited to prevent sliding and erosion. Two wall-plate drifts were started on September 23 and driven 52 feet in before arching was undertaken and timber sets were placed, proceeding toward the portal. Timbering was finished on October 12 and core removal two weeks later. Work on this heading was then suspended until after completion of Tunnel No. 1.

In the meantime, the drill jumbo which had been used in the diversion tunnel was rebuilt to fit the power-tunnel section. It was removed from the truck on which it had been mounted, provided with double-flanged wheels to travel on 60-pound rails, and the decks and wings were rearranged to meet requirements. This carriage is unusual in that all members of the framework are 6-inch, double, extra-strong pipe welded together so that all sections are interconnected, thus forming a very satisfactory air receiver. Compressed air is taken from the pipe line carried along one tunnel wall and is delivered by hose attached to quick-coupling connections on one leg of the jumbo. Thus, air outlets for the drifters can be conveniently located anywhere on the framework and troublesome tangles of hose lines on and around the drill carriage eliminated.

By this time the capacity of the approved waste area had been reached and it was necessary to make other arrangements for muck disposal. A turnout was therefore installed at the portal of Tunnel No. 2 and a short spur track run along the bank of Willow Creek. At the toe of the slope below the track was constructed a timber bulkhead with three 5x5-inch gate openings. It was designed so that rock dumped from the cars would slide by gravity through chutes into trucks below. The gates are provided with air cylinders for easy and speedy operation and with automatic devices for locking them when closed. Sufficient capacity was allowed behind the bulkhead to hold the muck from one tunnel round—roughly 220 cubic yards. From this storage area the excavated material is hauled in 10-cubic-yard end-dump Euclids to the primary crusher of an aggregate plant for processing.

Work was resumed in Tunnel No. 2 on December 30. Progress was slow at the start because timbering was required for a distance of 165 feet in from the portal. But from there on production figures began to climb with monotonous regularity and another record was soon scored. Footage for the 6-day week terminating January 29, 1950, totaled 227, bettering the earlier mark by 5 feet. This was not permitted to stand for long, however. The week ending March 19 saw an advance of 241 feet, or 40.2 feet per day. To accomplish this, an average of 794 cubic yards of rock (solid measure) had to be removed.

Equipment and methods used in Tunnel No. 2 are much the same as those already described in the case of No. 1, except that two 12,000-cfm. Root-Connersville blowers (one blowing and one exhausting) maintain an adequate supply of fresh air at the face. Each delivers to a 22-inch-diameter vent pipe. The way

in which muck cars are switched also differs. The empties are handled by a "cherry picker" and are swung to one side to allow a train to pass. The cherry picker is simply a horizontal boom (I-beam with a knee brace) pivoting on a rear leg of the jumbo. Suspended from the outer end of the boom is an air cylinder to which is attached a spreader bar with two hooks which quickly grip the ends of the car to be switched.

Trains are shunted to one side by a California switch—a movable double track 130 feet long with a spring-operated switch at each end, all welded rigidly to 8-inch channels laid laterally on 24-inch centers. The unit rests on the main track with blocking under the outer ends of the channels. In setting up the switch, one end is spotted at a splice in the main track, the connection is broken, and the rails are raised and spliced to the rails of the switch. The same procedure is followed at the other end, except that the main track must be cut because the likelihood of finding a joint at the proper location is remote. To move it ahead, the switch is slid along on the main track with the aid of three locomotives. The entire job of disconnecting, shifting, and resetting is done in the time it takes to drill a round, so that no delay is experienced in the tunneling operations.

During the month of April progress was hampered when a fault zone was encountered. Steel I-beams, rolled to conform to the horseshoe section and made up in two pieces for a bolted connection at the top of the arch, were placed for a distance of 102 linear feet before the rock was considered sufficiently sound to proceed without support. Timber lagging was used. Four hundred feet farther along, an underground stream was hit. The initial flow was measured at 900 gpm. After a few days, it leveled off to approximately 450 gpm., and at the time of writing it was coming in at a rate of about 200 gpm. Work was delayed while a drainage ditch was dug along one side of the tunnel and steel supports were set up for another 65 feet.

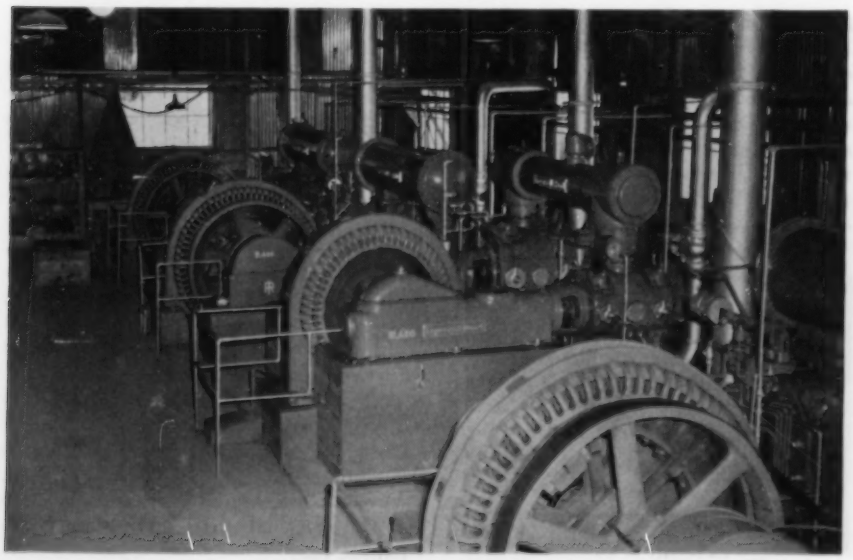
OPERATIONS STAFF

This picture was taken during a visit to the job by Harry W. Morrison (third from left), president of Morrison-Knudsen Company, Inc., which is joint contractor with the Bechtel Corporation. Others, from left to right, are: Paul Peacock, engineering representative of Southern California Edison Company; "Scotty" Harris, tunnel foreman; Carl J. Herslof, general superintendent of tunnels; James N. Wells, district manager for Morrison-Knudsen; and H. L. Leventon, construction manager.

Concurrently, with operations advancing downstream, a heading is being driven on a single-shift-per-day basis from the outlet portal of Tunnel No. 2. It will be carried only 600 feet in and will be used in mucking out 10,000 cubic yards of material for a surge chamber. A blacksmith shop, a battery house, a change house, and a make-up house were set up adjacent to that portal. Compressed air is supplied by four Ingersoll-Rand 500-cfm. portable units and ventilating air by two 5000-cfm. Connersville blowers. The jumbo is the same one that was used in Tunnel No. 1.

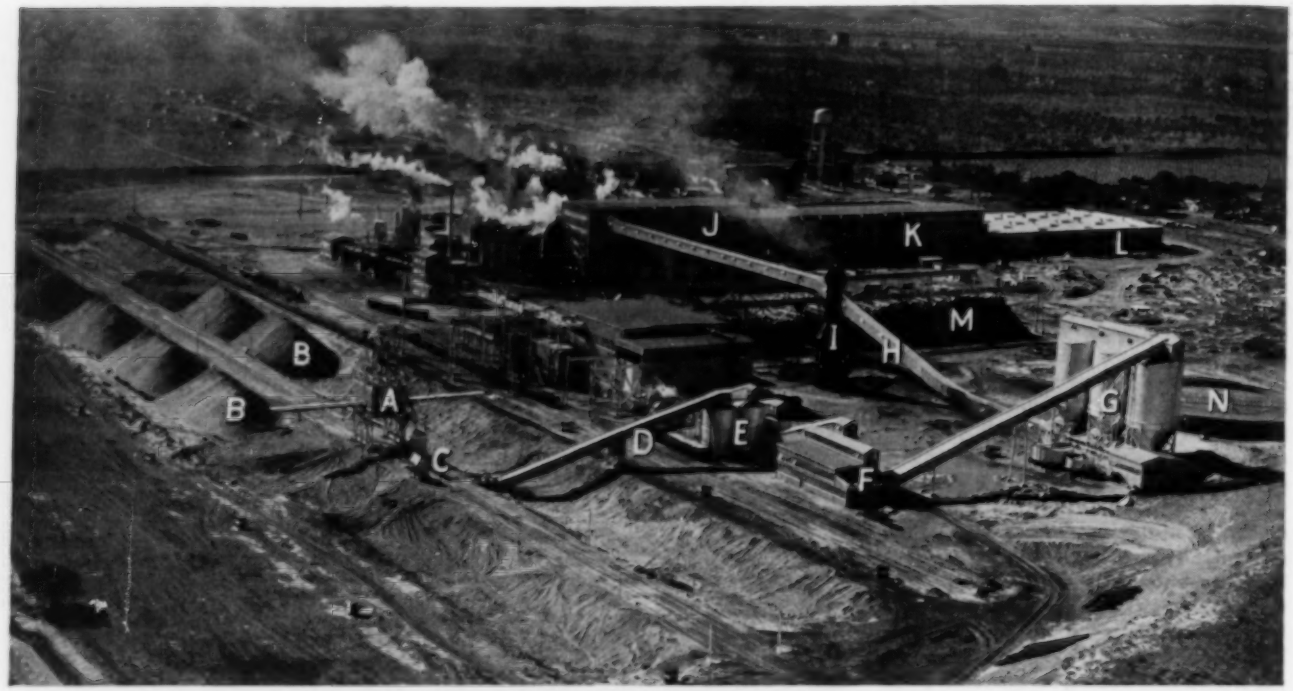
Completion of the portal excavation revealed the rock in the exposed face to be decomposed granite, a coarse granular material loosely cemented together. The nature of the formation made it necessary to adopt the same procedure followed at the upstream end to get underground. Consequently, two wall-plate drifts were started November 25 and driven until the rock gave evidence of being sound enough to permit arching and timbering, which were done simultaneously. After timber sets had been placed back to the portal, removal of the core was undertaken. It was January 29, 1950, before the drill carriage could be moved in and routine operations begun. Even then progress was slow and timbering had to be continued for a distance of 238 feet. At the time of writing, the heading had reached the center line of the surge chamber and preparations were underway for driving a lateral drift (the center of the surge chamber is offset 32 feet from the tunnel center line) and a raise, which is to be enlarged later to the full diameter of the surge chamber.

With 4000 feet left to go, it was expected that the two headings of Tunnel No. 2 would be joined in October, leaving the following to be completed: paving of the invert, placing of the concrete lining where required, setting of the steel liners at the portals, construction of the portal structures, and the laying across Willow Creek of the 15½-foot-diameter steel pipe that will connect the two tunnels. That done, the conduit will be ready to deliver water from the reservoir to the turbines and generators that will add 84,000 kw. to the 430,000 kw. now being produced by the five existing plants which make up the Big Creek System of the Southern California Edison Company.



MAIN COMPRESSOR PLANT

Seven stationary compressors at Willow Creek, having a combined capacity of 7000 cfm., have furnished most of the air for tunnel driving. The four machines shown are Ingersoll-Rand synchronous motor-driven 1000- and 1200-cfm. units.



AERIAL VIEW OF PLANT

Letter *A* indicates the suction chip loader-unloader which transfers the shipped-in material from cars to storage piles, *B*. From the stockpiles it loads the chips into electric cars, *C*, which dump them into a feeder for conveyor *D* that carries them to blending tanks, *E*. Then they go to the screen room *F* from which they are conveyed to storage silos, *G*. As required to feed the mill, they are transported by the conveyor *H* to the pulp plant *J*, passing en route through the bark-disposal unit *I*. *K* is the machine room, *L* the shipping department, *M* the log storage area, and *N* the Dorr Clarifloculator. The new mill is located 4 miles from Antioch, Calif., on the San Joaquin River.

Fibreboard Products Inc.

Pacific Coast's Most Modern Board Mill Turns Sawmill Waste into Container Materials

L. A. Lawrence

NO MONARCH of the days when kings were really kings was ever half so fastidious about the containers in which his food and drink were served as is the American workingman today. The process of becoming the most container-conscious of nations seems to have developed gradually up to well past the turn of the last century, and then advanced rapidly to the point where it became a sort of obsession or crusade. Nowadays, high quality in food or other essential items of everyday use is no assurance of marketability unless they are smartly packaged. The material from which a large proportion of our throw-away cartons and containers is fashioned is fibreboard, and this article deals with a plant—the most modern on the Pacific Coast—which converts cellulose fibres of coniferous woods into products of this kind.

The establishment is located on the bank of the San Joaquin River some 4 miles from Antioch, Calif. It is part of a 50-million-dollar plant-betterment program initiated by Fibreboard Products Inc. in 1946 and is expected to require a decade to bring it to completion. Incidentally, it is also part of California's rapid transformation from a pastoral to a highly industrial economy. Each Californian doubtless uses about two containers daily, the reported national average for every man, woman, and child,

ADVERTISING ITS PRODUCTS
This signboard at the Antioch plant shows some of the principal products of the fibreboard that is made there.

but many of the state's citizens can probably remember the day when none excepting boxes and barrels were made on the West Coast.

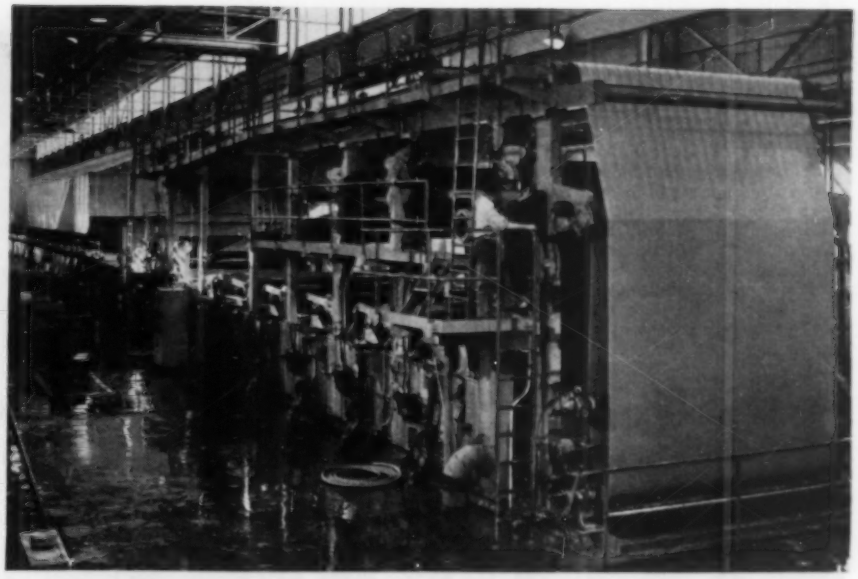
Fibreboard's current daily output amounts to some 1000 tons of paperboard products and had its beginning in the pioneering newsprint business—when the Crown Williamette Paper Company, a newsprint manufacturer, merged with the Zellerbach Paper Company, a marketer of paper commodities, to form the present Crown Zellerbach Corporation. The latter concern owns approximately a half interest in Fibreboard Products Inc., which now operates fifteen plants at various points on the Pacific Coast ranging from Los Angeles northward to the State of Washington, where several are located. The balance of the stock is held by Paraffine Companies, Inc.

The new factory at Antioch sets several precedents in West Coast paperboard manufacture: among other things, it is the first of its kind to make 9-point

corrugating material entirely from coniferous wood and is the only kraft mill in California. Its future supply of raw stock was assured in 1947 by the purchase of 75,000 acres of timberland in eastern California and in Nevada. A private railroad has been built 7 miles from Truckee, Calif., on the Southern Pacific Railroad to a headquarters' logging camp at Hobart Mills, from which a surfaced truck road extends for a distance of some 21 miles. Red and white firs are principally utilized, and the company hopes, by selective logging and by purchase from various tributary sources, to maintain a permanent supply and a continually producing forest.

To conserve timber and to make the fullest practicable use of all available material, the concern is buying both sawmill slabs and logs. The latter are now being shipped to Antioch from three points on the Northwestern Pacific Railroad; and where the volume of sawmill waste has warranted it, Fibreboard has installed a chipper and conveying apparatus and is transporting chips in special railway cars. Other sources of supply are California planing mills and box factories which previously had disposed of their waste products by delivering them by means of conveyors to screened burners. Much of this material reaches the plant by truck or rail.

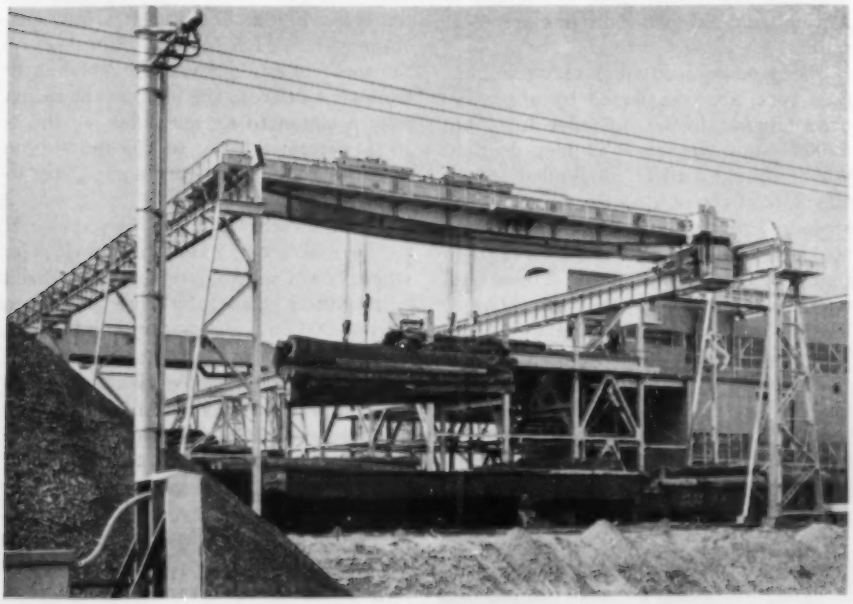
Two products are manufactured at the Antioch plant: a so-called Tuf-Fir 9-point (0.009-inch-thick) kraft corrugating material for shipping cartons, and kraftboard for food containers, milk cartons, file holders, tags, etc. In the case of unbleached Tuf-Fir, the daily output is about 110 tons of pulp, which calls for some three million board feet of waste wood per month. Standard kraft pulp is produced at the rate of approximately 150 tons per day, of which 125 tons is run through the bleaching department. The kraft mill consumes around four million board feet of log wood per month.



CYLINDER BOARD MACHINE

Bleached kraft for food containers, etc., is made in a continuous sheet 136 inches wide on this Black-Clawson machine. The felt seen at the right picks up successive layers of wet cellulose fibres from each of the several wire-mesh cylinders over which it passes, thereby building up the thickness of the sheet, as desired. When dry enough to support its own weight, the sheet leaves the felt and travels through pressing and drying rolls to be wound on reels at the discharge end.

Logs arrive at the plant in gondola cars with sets of cable slings in place so that a 100-foot, 50-ton bridge crane can pick up an entire carload and deposit it either in an 800-foot-long storage area or on a live deck for immediate use. The latter is equipped with two sets of transfer chains, which move the logs to a bull chain which, in turn, carries them into the mill, being trimmed en route with either a 96-inch circular cutoff saw or a 10-foot dragsaw. Trimmed logs are knocked out of this chain haul by a Sumner kicker powered with air from the main powerhouse battery of three 900-cfm. XRE Ingersoll-Rand compressors. Then they are conveyed by transfer chain into a shrouded chamber containing a Bellingham-type hydraulic barker whose nozzles deliver water at 1200 pounds pressure. The operator, who works behind a shield of heavy safety glass provided with automatic wipers, has an elaborate electropneumatic "keyboard" that gives him complete control of both nozzles and log during the barking process.



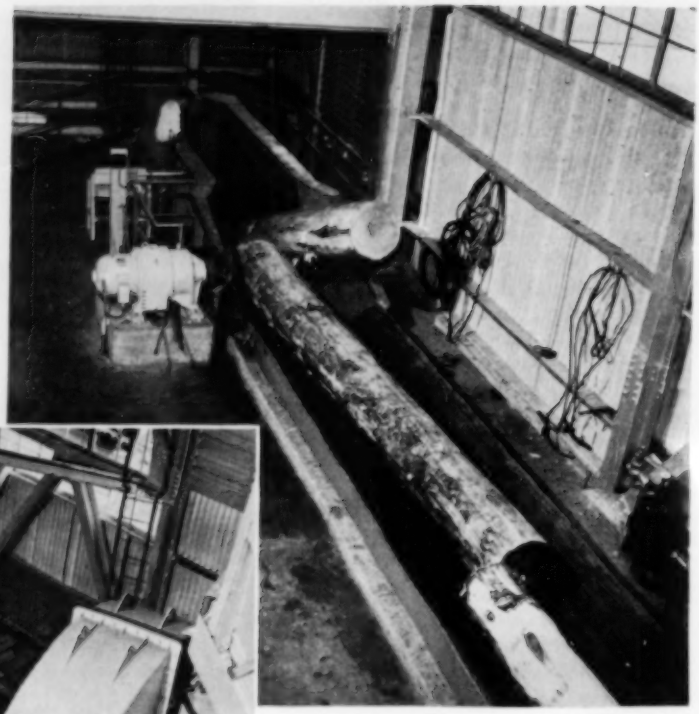
UNLOADING LOGS

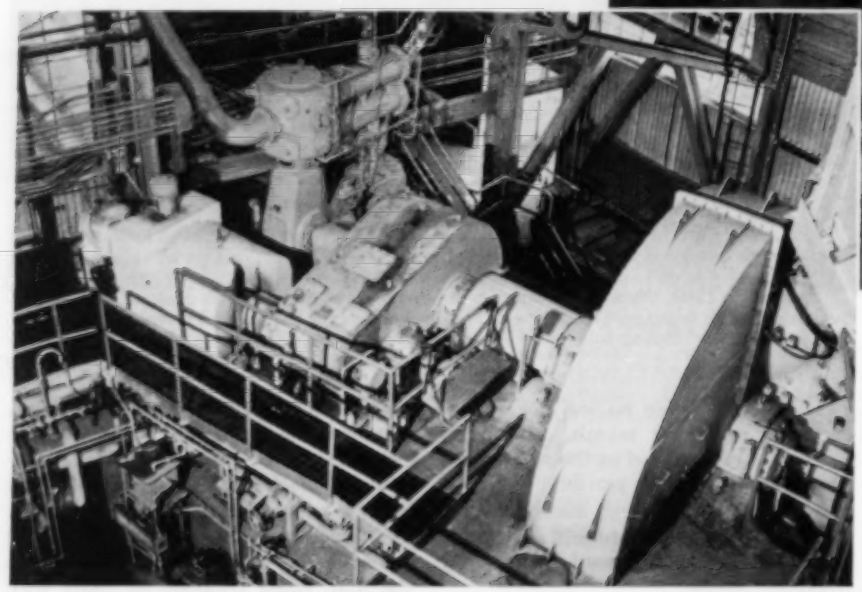
Raw material arrives in two forms—in chips made from waste originating in other woodworking plants and in logs that are converted into chips. The logs are shipped in gondola cars and have chains slung around them ready for lifting by a bridge crane and transportation either to a storage area or to a live deck at the mill for immediate processing.

Barked logs less than 42 inches in diameter go by way of a series of vee rolls to one of two chippers, while those of oversize are slabbed on a 9-foot band mill of the most modern type. There, again, solenoid-controlled air kickers and dogs toss the heavy logs about like matchwood and secure them on the sawmill carriage with unbelievable ease. The largest chipper (175 inches) is powered by a 2500-hp. steam turbine operating at 600 pounds pressure and driving through a Farrell-Birmingham gear unit. Into the maw of this huge machine go the logs of maximum diameter (42 inches)

DIVIDEND-PAYING BRAKE

The largest log chipper in this mill is unique in two respects. It is reported to be the first of its kind to be driven by a steam turbine and utilizes an air compressor as a brake. Logs up to 20 feet long and 42 inches in diameter are fed to it from the floor above at the rate of a foot a second, as shown at the right. The chipping knives are mounted on a heavy 175-inch-diameter rotating element within the housing near the lower-right corner of the picture below. Left of it, the drive shaft extends to and through a Farrell-Birmingham gear unit which is powered by the General Electric 2500-hp. turbine at the left-center. At the far end the shaft is connected to an Ingersoll-Rand Type XVH air compressor. This unit operates all the time the chipper is in service and acts as a brake to bring it to a stop when it is shut down. Without it, the rotating element would run for hours on its built-up momentum. The compressor stops it in about eight minutes.





for chipping at the rate of a foot per second.

It was realized by the plant's designers that the rotor of the big chipper would spin on its antifriction bearings for hours after the turbine had been shut down unless some means for braking it to a stop were devised. Deceleration by a suitable brake was studied, but it was discovered that it would involve no additional cost to drive an air compressor from the gear unit, operating it continuously and letting it serve to decelerate the rotor after the turbine driver was shut down. The available floor space was limited, but it permitted the erection of a compact 19½&12x10-inch XVH Ingersoll-Rand machine. It brakes the chipper to a stop in about eight minutes and has proved helpful in meeting the sawmill air requirements.

Material from the 175-inch chipper is carried by conveyor to a surge bin which insures even feed to three chip screens, oversize going to a hammermill-type rechipper and back into the system. This stock is used for the manufacture of bleached kraftboard, but rejected fines are diverted and converted into the less-exacting unbleached Tuf-Fir pulp made principally from slab wood reduced to chips at sawmill sites and from box-factory and other waste that is shipped to Antioch and chipped there in a hammermill.

Slab-wood chips, which arrive in gondola cars, are transferred by a gantry-type suction loader-unloader into two 1900x75-foot trenches 10 feet deep in which enough can be stockpiled to run the plant the winter season through. The stored chips are picked up as needed by the same unloader and delivered to a pair of electric track cars. These haul them to a conveyor system that charges a 10,000 cubic-foot blending tank. An identical tank handles box-factory and miscellaneous waste. Both are equipped with rotary plate feeders dumping onto a conveyor which discharges onto screening and resizing apparatus. The now completely blended materials from the two waste sources go to a chip silo ready to be carried, as needed, to the No. 1 or Tuf-Fir side of the mill.

After washing and then dewatering with apparatus designed by Fibreboard, the chips are delivered to three Asplund defibrators with B-K reaction chambers. The next step takes the material through hot-stock refiners equipped with stainless-steel disks; and, finally, it is fed to a Pusey & Jones 156-inch wire Fourdrinier machine which transforms the wet pulp into corrugating material of controlled texture and thickness. The intricate machine is divided into seven sections for driving purposes, each having its own electric motor equipped with an amplidyne-regulated generator. It is now being given sufficient drying capacity to operate at 600 feet per minute, though a master control system provides for optional speeds from 300 to 1200 feet per minute. Incorporated in the latter is a series of electric tachometers, one in each section. The instant the speed of any one varies even slightly from that desired, the instrument transmits a signal to an amplifier which, in turn, passes it along to the amplidyne field control of the section's generator to rectify the speed.

Chips which form the raw material for the mill's No. 2 bleached-kraft side, where board suitable for food containers is produced, travel by conveyor from two 64,000-cubic-foot storage silos to a telescopic spout charging three 3800-cubic-foot stainless-steel-lined digesters electropneumatically controlled from a central station in the digester room. Digesters blow into a conventional blow tank, the flash steam going to a Foster-Wheeler heat-recovery unit whose heat exchanger has stainless-steel tubes. The 12-inch blow lines are thought to be the largest that have ever been installed, and permit blowing the digesters in eight to nine minutes.

The stock is next washed in a 4-stage system provided with knot screens, the rejected material passing to the Tuf-Fir side. After washing, the pulp is pumped

to a screen room for deckering or thickening by twelve 14-plate Impco stainless-steel screens with Dunbar drive and bronze vats. Now it is ready for the bleach plant where it is treated, first, in a low-density chlorination tower; second, in a high-density caustic extraction tower, followed, without washing, by a low-density soak; and, third and fourth, by high-density hypochlorite. The stock then flows by way of a consistency regulator to the preparation room where four Sutherland refiners turn out the liner and filler pulp for the No. 2 board machine.

When a Chinaman in 105 A.D. gathered paper fibres from a pulp solution with felt, he hit upon a basic principle still used in modern cylinder machines. The one installed in Fibreboard Products' mill is of the Black-Clawson type, a massive piece of equipment 136 inches wide, with a selective speed range of 100 to 500 feet per minute provided by the same kind of multiple-generator drive as on the No. 1 unit. Its total connected horsepower, however, is 555 as against 720 for the Fourdrinier.

Cylinder board machines can build up multiple plies by picking up, successively, several webs of fibre from screened rolls revolving in vats of liquid stock of carefully regulated consistency. This is achieved by means of endless belts of felt and by a system of rollers arranged so that the felt is pressed down on the aforementioned screened rollers to facilitate picking up the webs of fibres. The characteristics of each ply or lamination are controlled in order to produce the uniform, high-tensile strength board desired for milk and food containers.

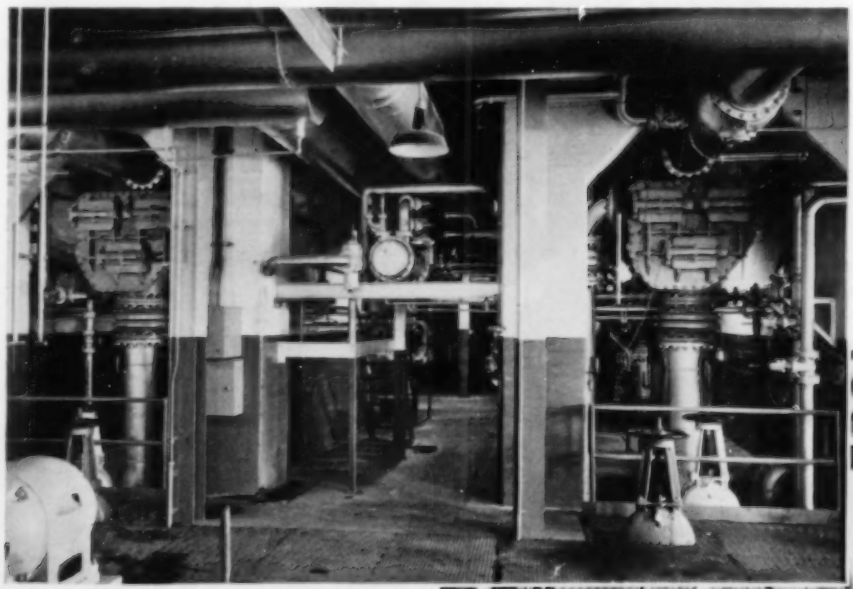
Both board machines are equipped with hoods and air-exhaust fans, and an elaborate arrangement of heating and ventilating systems with thermostatic controls supplies all departments with filtered air. Some fifteen million gallons of water is required daily. It is taken from the San Joaquin River and treated with Bayliss-Sol before reaching a 186-foot-diameter, 600,000-gallon Dorr Clarifloculator. All piping within the plant is either made of stainless steel or specially treated to protect it against corrosion.

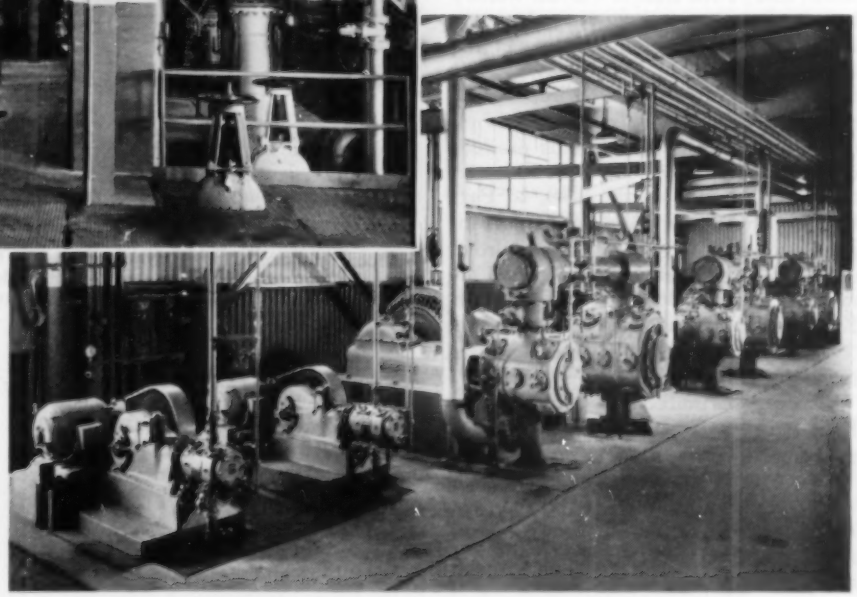
Three 5000-kva. turbogenerators produce all the electrical energy for the mill. The turbines are served by two Ingersoll-Rand surface condensers supplied with raw water from the river for cooling. The powerhouse is equipped with Babcock & Wilcox boilers, each capable of developing 160,000 pounds of steam per hour at 600 pounds pressure and 750°F. There are three Type 4RTS 6-stage boiler-feed pumps of which two are turbine-driven and one motor-driven. All the boilers in the plant, including that of a chemical-recovery system generating approximately 100,000 pounds of steam per hour at 600 pounds pressure and 750°F., are provided with Diamond Air Puff soot blowers. The necessary air for these devices, as well as for instrument control, is furnished by three Ingersoll-Rand 9&4x9-inch ES2 compressors. Two 5x5-inch ER units also serve for instrument control, and these machines are installed alongside three XRE 18&11x12-inch compressors, the source of the mill's principal air supply.

The mill is composed of six different buildings, all integrated and representing some 329,000 square feet of floor space. The main unit, of structural steel and concrete, occupies an area of 1000x 200 feet and is equipped with three traveling cranes. There is a testing laboratory with two main divisions: an analytical and pulp department and a board and bacteriological department. All buildings are illuminated with mercury-vapor and fluorescent lamps and protected against fire by an elaborate system including sprinklers and a 100,000-gallon elevated tank.

The Antioch plant was constructed under the direction of N. M. Brisbois, vice-president of Fibreboard Products Inc., and Leland S. Rosener, consulting engineer, and employs some 400 people. Swinerton & Walberg was the general contractor. C.P.R. Cash serves as resident manager, having recently succeeded C. M. Stitt who has been made manager of Fibreboard's newly established Central Engineering Division. T. N. Bland is president, R. E. Bundy is vice-president in charge of production, and A. H. Lindquist is plant engineer.

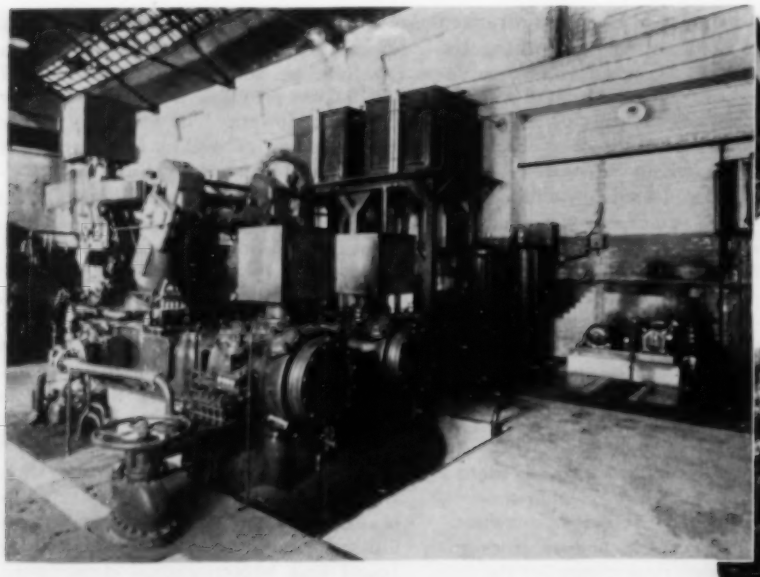
Incorporated in 1927, Fibreboard Products Inc. has become one of the three largest producers and converters of paperboard packaging materials in the United States.





AUXILIARY EQUIPMENT

In the group of five Ingersoll-Rand air compressors at the right, the three large XRE units furnish compressed air at 100 psi. pressure for general plant purposes. The two smaller machines supply some of the air for instrument control. The other picture shows the floor underneath the three 5000-kva. turbogenerators that supply the mill with electric power. On each side, near the ceiling, are the heart-shaped ends of Ingersoll-Rand surface condensers that serve the turbines of the generating units.



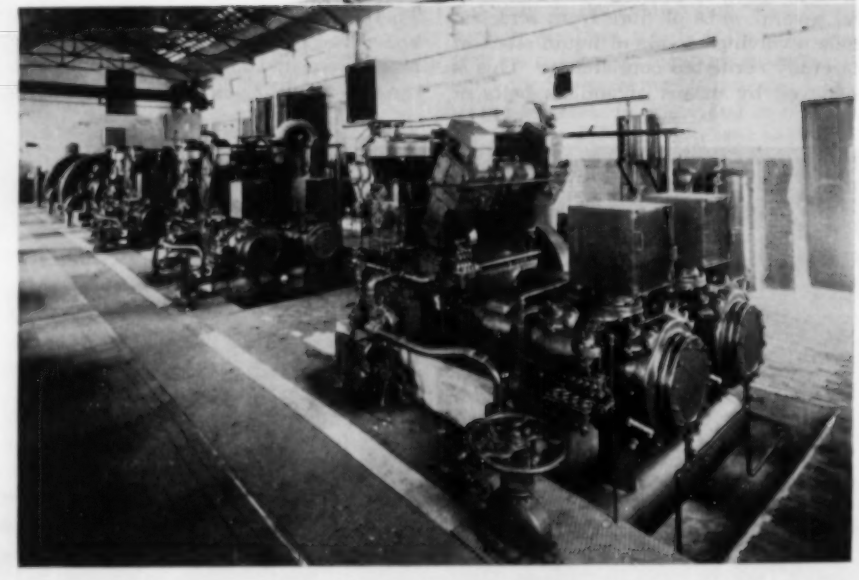
New Compressors Serve Port Said Sewage System

THE CITY of Port Said, Egypt, occupies the tip of a narrow strip of treeless land that separates the Mediterranean Sea and Lake Menzala. It came into being in 1859 when the Suez Canal scheme was getting underway and is the northern terminus of that famous waterway. Following the opening of the canal in 1869, the city grew rapidly in population as well as in area, which was extended by depositing sand dredged from the inner harbor to facilitate the passage of ships and by partially draining Lake Menzala so as to lower its surface.

In the days when most ships burned coal, Port Said became the refueling station for vessels passing through the canal, and at one time it was the world's largest maritime coaling depot. Its early expansion was a direct outcome of the services it rendered the waterway, but in 1902 it began to take on importance as a point of export for cotton raised on the rich Nile delta land. This product was transported by boat from Matarie, on the other side of the lake, to Port Said, where it was reloaded into ocean-going ships. The opening of a railroad connecting the port with Cairo in 1904 made it a competitor of Alexandria for Egypt's export trade and also put it on one of the main traveled tourist routes from Europe.

Because it is built on low-lying ground, Port Said has always had a drainage problem, and this became more serious as it continued to grow. To better cope with the situation, the authorities began the construction of a system of sanitary and storm sewers in 1914. The lines discharge into a collecting basin in the southern part of the city, and from there the sewage is lifted by means of air-operated sewage ejectors into mains that deliver it to a treatment plant located on the western side near the shore of the lake.

These ejectors, which are used in many communities where basements are below sewer level, operate on the displacement principle. Sewage enters a closed vessel near the bottom, and when the latter is nearly full a float opens a valve in a connecting compressed-air line and admits air into the top of the vessel. At the same time, a check valve in the sewage inlet pipe is closed and a valve in an outlet pipe at the bottom is opened. The pressure of the air against



NEW COMPRESSOR PLANT

At the bottom is a general view of the engine room, with the three new diesel engine-driven XVO compressors foremost. When these units were put in, all discharge piping was run under the floor, not overhead as previously. A close-up of one of the machines is at the top-left. Back of it, against the wall, are elevated square tanks for the daily fuel-oil supply. At the extreme right, on the floor, is a small motor-driven compressor that furnishes air at 250 psi. for starting the diesel engines. The two 600-cubic-foot air receivers are shown at the top-right. The down pipe is the outlet through which air is fed to the mains that deliver it to the sewage ejectors.

the sewage forces it out of the container and up into the main running to the disposal plant. As the liquid level drops, a cup in the center of the vessel that has been left unsupported descends until a connecting rod closes the air-inlet valve and opens an exhaust valve through which the pressurized air in the container escapes to atmosphere. The cycle is then repeated, the ejector continuing to fill and discharge automatically as long as there is sewage to pump. The apparatus is dependable and is not troubled by solid matter or by corrosives that render conventional pumps unsuitable for the service.

The original facilities provided at Port Said included an air-supply station containing four horizontal semidiesel engines each driving, through a coupling, a radial-type compressor hanging on its frame. By 1939 this equipment had become worn to the point where it would no longer function efficiently and the increased population had created a demand for greater air capacity to handle the load. Consequently, the administration decided to enlarge the plant, and an electric-driven vertical compressor was put in.

ENGINEERING AND OPERATING PERSONNEL

Riad Ahmed Bey, chief engineer of the compressor station, stands at the far right in the front row. Next to him, in order, are Youssef Yacoub Bey, Hussein Ismail Bey, and Zaccaria Bey, directors of departments in the Egyptian government's organization in charge of main drainage. Second from the left end is M. Nadel, technical manager of The Tractor & Engineering Company S. A. E. which acted as sales agent in the purchase of the new equipment and had charge of its installation. Jack Danzker, chief erector for the firm, is at the extreme left. Grouped in the rear are members of the station's operating staff.

COOLING TOWER

Cooling water for the engine and compressor cylinders flows into a sump from which it is pumped into a tank at the top of this tower for cooling and recirculation. The tower is of the natural-draft chimney type.

The outbreak of World War II prevented doing anything more then, and by the time the conflict was over the operating and maintenance expenses on the old machines had become prohibitive and it was realized that it was in the interest of economy to replace them, especially as they could no longer be relied upon safely to meet the requirements of the still expanding city.

After due investigation and calling for bids, the authorities purchased three Ingersoll-Rand Type XVO air compressors. Each machine consists of a 4-cylinder, 4-cycle, V-type diesel engine direct connected to two horizontal compression cylinders. The frame, compressor cylinders, and running gear are the same as those on the company's widely accepted Type XVG gas engine-driven oilfield compressor and the general design is similar. Each unit delivers 1285 cfm. at 30 psi. pressure. A new natural-draft, chimney-type cooling tower was erected in the station yard. From a tank at the top, water flows by gravity to the machines, where it is circulated through the power and compressor cylinder jackets by pumps incorporated in the units.

Because the subsoil at the compressor-plant site is mainly sea sand and not firm enough to insure satisfactory foundations, a concrete mat 15 inches thick was poured over the entire area and on it were placed individual concrete blocks, one for the support of each machine. Discharge lines were run underground to two 600-cubic-foot air receivers outside the station. These and the piping were manufactured in the Cairo plant of The Tractor & Engineering Company S.A.E., which also took care of all the installation work.

Connections with the air mains serving the ejectors was made one night during a period of low load, and the new compressors went into operation without incident. They relieved a serious situation, for the existing equipment had by that time reached a stage that threatened frequent breakdowns, making it not only difficult to handle the sewage but also constituting a hazard to the health of the population.

Before accepting the new equipment, the authorities subjected it to thorough tests. Each compressor was run for ten days under normal service conditions, without interruption or adjustment. Auxiliaries, consisting of a small high-pressure compressor for starting the diesel engines and of pumps for transferring cooling water from a hot-water sump to the top of the cooling tower, were likewise tested. The facilities went into operation early this year, and at the time this information was transmitted had been running continuously without trouble for more than six months.

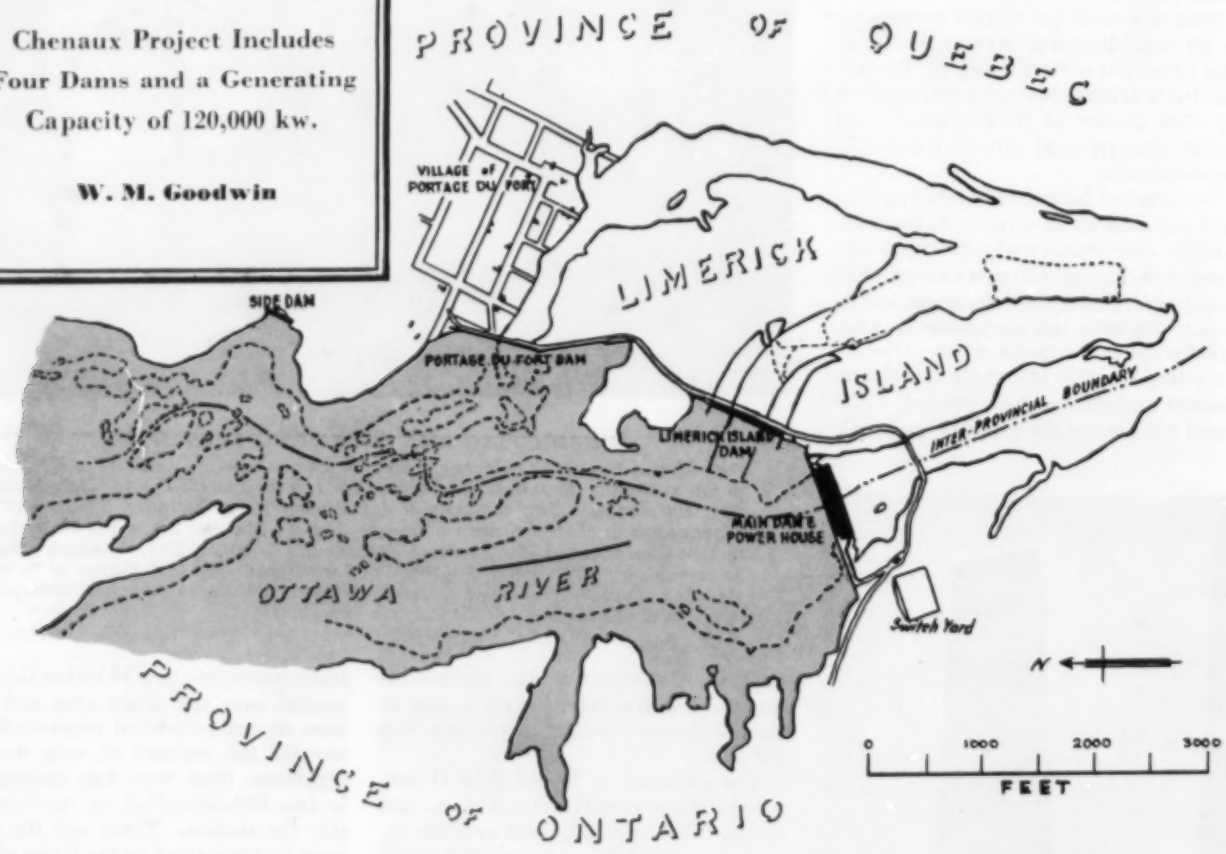
Ottawa River Power Development

Chenaux Project Includes Four Dams and a Generating Capacity of 120,000 kw.

W. M. Goodwin

DIAGRAM OF PROJECT

The $29,800,000 undertaking involves the construction of four dams and a powerhouse that will contain eight 20,000-hp. generating units. The reservoir (indicated by shading) will cover 4600 acres and extend 7 miles upstream, inundating numerous islands.

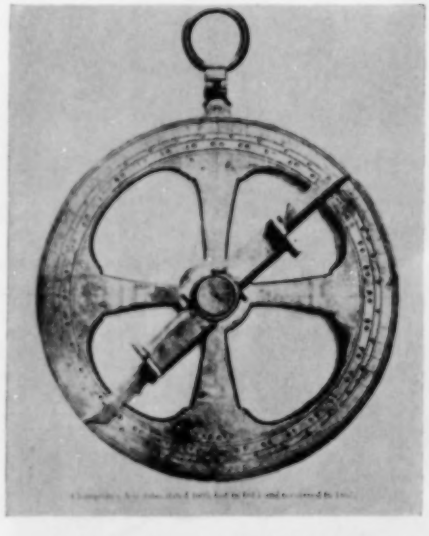


WORK on the Chenaux plant, the second of the large Ottawa River power projects in the present campaign of the Hydro-Electric Power Commission of Ontario, is progressing rapidly at a point 75 miles upstream from Ottawa and 60 miles below Des Joachims. It was begun in the spring of 1948 and involves the construction of four dams with an aggregate length of 4000 feet to make use of the 40-foot fall between the tailrace of the Bryson powerhouse and Lac des Chats, the impounding reservoir of the Chats Falls station.

Chenaux is the plural of the old French word *chenal*, from which our word channel is derived. The name was given to this section of the river more than 300 years ago by the French explorers who poled and tracked their canoes up against the swift currents in the rock-rimmed channels. At Portage du Fort (Carrying-Place of the Strong) they took out their craft for a long trek around a stretch of water too turbulent to navigate.

The earliest record of the Chenaux Rapids is found in the journal of Samuel de Champlain. In 1613, five years after he had founded the settlement at Quebec, he set out to explore the interior of the new continent. His writings, in the archaic French of that time, give a vivid account of the trip, taken in two canoes with three Frenchmen and two Indian guides. Today, one can follow the landmarks he mentions. At a point opposite the present village of Portage du Fort, at the foot of the swiftest stretch of rapids, the Indians conducted the party across a portage leading to a chain of lakes that rejoins the Ottawa 30 miles above. It was on this portage that Champlain lost his astrolabe, an instrument used by mariners and travelers from ancient times until the eighteenth century to ascertain latitude by an observation on the sun or stars.

Champlain's astrolabe was found in 1867 by a farm boy while clearing land for cultivation. It was taken to Toronto, where it was acquired in 1901 by an American connoisseur, Samuel V. Hoffman, of New York, who added it to his large collection of these scientific instruments. Until it disappeared, it had been



CHAMPLAIN'S ASTROLABE

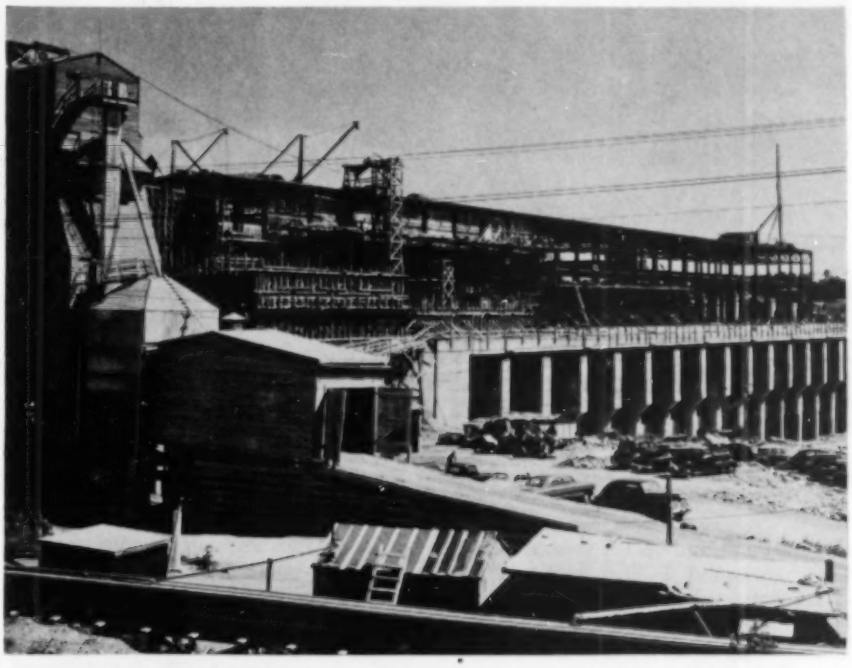
The instrument shown, which was used for sighting on the sun or stars to determine latitude, was lost by the explorer when he first penetrated the Chenaux area in 1613. It was found by a farm boy in 1867 and is now in a private collection in New York.

the great explorer's constant companion, indicating the care with which he conducted his journeys and made his records.

The site of the Chenaux project, the features of which are shown in an accompanying plan view, has natural advantages that have permitted its development at moderate cost per horsepower despite the comparatively low head of 40 feet. The rapids between the islands below it and up which Champlain's canoes were poled with difficulty are now pretty well flooded by the waters backed up by Chats Falls Dam, 25 miles downstream. Limerick Island, on the Quebec side of the site, has facilitated the work of damming the Ottawa, which formerly flowed around that rock formation in two natural channels. The island, which has a maximum width of half a mile, was found to be high enough on the west side to form a natural barrier and part of the Chenaux dam, as well as to provide a foundation for the main control or Limerick Island Dam.

Chenaux Dam and power plant are in the Interprovincial Channel between Limerick Island and the Ontario shore, putting half of the generating units in Quebec and half in Ontario. By agreement, however, all the power will be allotted to the latter province for a long term of years. The Portage du Fort Channel, which has been blocked by the secondary control or Portage du Fort Dam, was found to be too small to take the full flow of the river without damage to property along its banks, so a natural depression in the center of Limerick Island has been used for flood discharge. It needed but comparatively little rock excavating to deepen it and to remove the rock barrier at the upper end to convert it into a channel of sufficient section to accommodate the Ottawa at maximum flow. That was the first work undertaken, and necessitated the excavating of 377,000 cubic yards of material—150,000 of earth and 227,000 of rock, actually 267,000 cubic yards more than was required for the dams, tailrace, and powerhouse combined (110,000 yards).

The discharge channel is 310 feet wide and 1500 feet long and was used to dewater the site after the completion of Limerick Island Dam when both natural channels were closed by means of cofferdams. The latter dam is 1100 feet long and includes a spillway section with six 40-foot-wide sluiceways with steel gates



HYDRO NEWS PHOTOS

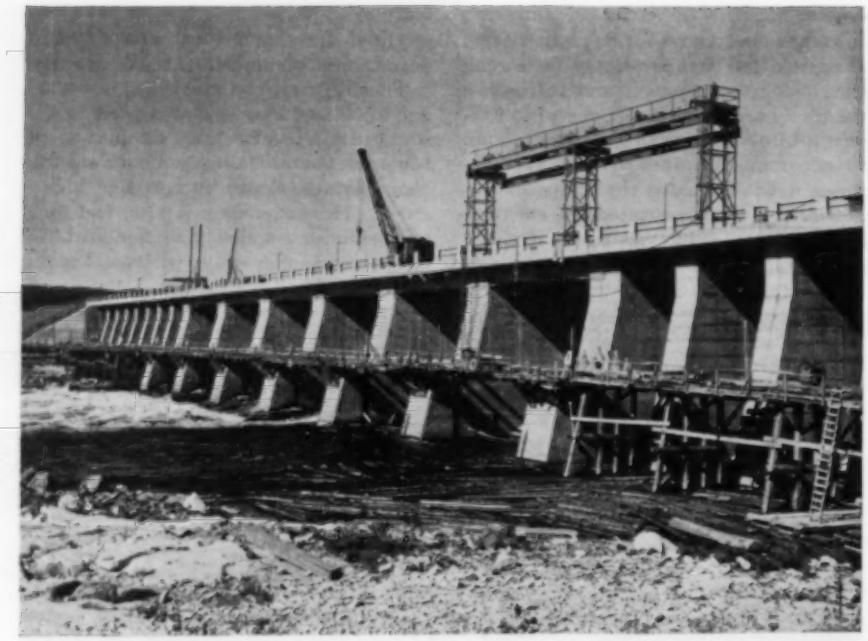
POWERHOUSE

The powerhouse will rise higher than the main dam situated immediately upstream. It is shown in the view at the top, with the concrete mixing plant (left) from which concrete is pumped to pouring sites through 8-inch pipes. The unfinished interior of the station, with the propeller-type runner of one of the generating units in the foreground, is seen directly above. These pictures were taken last July.

and sixteen stop-log sluices. These, together with eight stop-log sluices in the Portage du Fort Dam, will discharge any river flow in excess of plant requirements. Combined, they have a capacity of 200,000 cubic feet (1,250,000 gallons) per second, which is greater than that of the Des Joachims sluices. Final closure of the river will be made in the sluicegate section of Limerick Island Dam.

At the upper end of Limerick Island is Portage du Fort Dam, a simple gravity bulkhead 1400 feet long with a series of sluices, as already mentioned. These will permit a moderate flow of water past the shore on which the village of the same name is situated. Running across the top of the structure is a roadway that approaches it from Ontario by way of Limerick Island Dam and a bridge spanning the Interprovincial Channel a short distance below the Chenaux powerhouse. The fourth dam is a small structure—100 feet long—that was required to close a gully 2000 feet north of Portage du Fort.

The main dam is 1400 feet long and consists of a 900-foot gravity-type bulkhead section and a 500-foot intake structure. It will form a headpond or reservoir with an average width of 1 mile that will extend 7 miles upstream to the



LIMERICK ISLAND CONTROL DAM

This 1100-foot-long dam, the first of the Chenaux structures built, is designed to discharge surplus water during flood periods through six 40-foot openings provided with steel gates and sixteen stop-log sluices. Below it was dug a discharge channel 310 feet wide and 1500 feet long to carry the river flow while the main dam site was unwatered for excavation and construction.

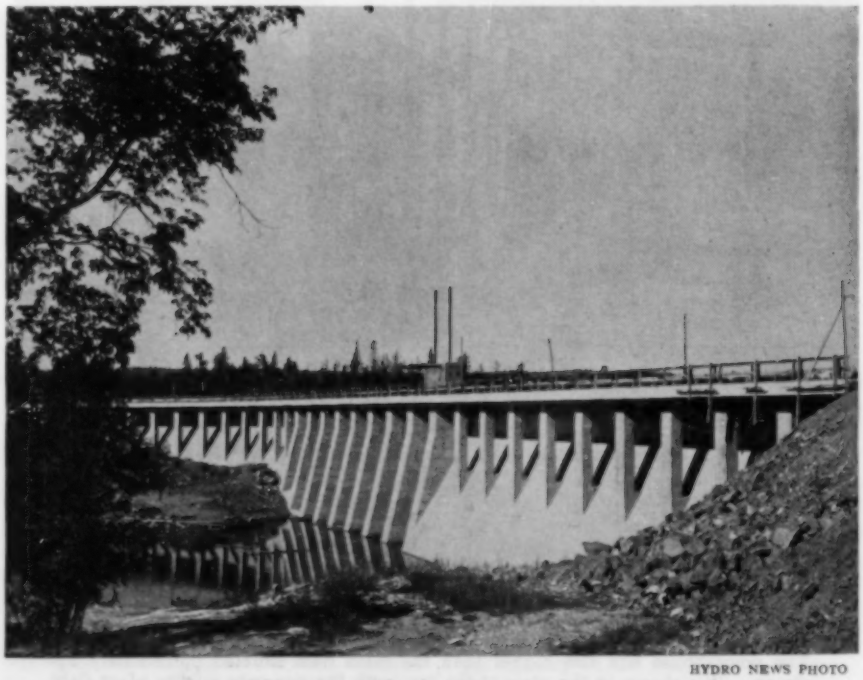
Bryson plant and up the western side of Calumet Island to the Rocher Fendu site, which is yet to be developed. Though covering an area of but 4600 acres—considerably smaller than the other impounding basins on the Ottawa—it is large enough to maintain a constant head without the need of overmuch attention to the coördination of the flow through the Bryson and Chenaux dams. A considerable number of islands will be submerged beneath the waters of the new lake, as the plan indicates.

As more than half of all the concrete used on the Chenaux project (235,000 cubic yards) will enter into the construction of the main dam and powerhouse, an unusual plant has been set up on the Ontario shore overlooking the site to mix and place the material. Timber storage bins for coarse and fine aggregates, sufficient to feed the mixing plant for six hours' continuous operation, have been built on the sloping bank of the river where they can be filled conveniently by trucks. A conveyor belt, supported by a Bailey-bridge structure, carries the aggregates to the plant, which contains two 2-cubic-yard mixers with a combined capacity of 120 cubic yards of concrete an hour. Mixing is done semi-automatically—that is, batching is manually controlled except for the cement and water—and three double Pumpcrete machines deliver the concrete to the forms by way of 8-inch pipes.

Although the project has not involved much relocating of highways and railways, it has been necessary to clear 2000 acres of land between Portage du Fort and the Bryson plant. Much of the timber cut has been sawed into lumber, of which 9,500,000 board feet, or 380 carloads, will be required for construction and other purposes before the job is completed. Steel needs total 8200 tons, and 6500 tons of equipment had to be assembled. A camp with administrative and engineering offices, a hospital, a recreation hall, and accommodations for 900 men has been set up within a short distance of the site. Bunkhouses are partitioned for greater privacy and have hot and cold running water and other conveniences. Well-balanced meals are provided in a spacious cafeteria for the working force on the job, which totaled 1300 in February of this year.

The Chenaux powerhouse, unlike hydroelectric plants in Canada operating under greater heads, will tower above the dam. It will be 600 feet long and house eight generating units rated at 20,000 hp. each. The turbines will be of the propeller type, with the generators installed below floor level. The six main transformers, each with a capacity of 23,000 kva., will be on the tailrace deck. Three of the generators are expected to be in operation in January, next, and will add their power by way of a 184-mile, 230,000-volt transmission line to the Southern Ontario System.

With their own engineering and construction staffs fully occupied with other important undertakings, the Hydro-Electric Power Commission of Ontario retained H. G. Acres & Company, Limited, of Toronto, to design the Chenaux plant. Pentagon Construction Company, Limited, of Toronto and Montreal, are the contractors. All the work has been conducted under the supervision of Hydro's headquarters and field staffs. Constructed at an estimated cost of $29,800,000, the project is scheduled to be in full operation before the end of 1951.



HYDRO NEWS PHOTO

PORTAGE DU FORT DAM

This structure is 1400 feet long and will close off the former river channel on the north side of Limerick Island. Provision is being made so that some surplus reservoir water can be discharged through it during flood times.

Choosing a Tunnel Route with Dynamite

EXPLOSIVES used to advance tunnel headings have long been fired in holes driven with air-operated rock drills. Now they are being employed in the new science of geophysics in order to determine what course is the best one for rock tunnelers to follow.

These pictures show geologists of the U. S. Bureau of Reclamation exploring the subsurface of the Frenchman Hills near Quincy, Wash., to locate the most satisfactory and the least-expensive route for a bore that is to carry irrigating water to land being brought under cultivation in the Columbia River Basin.

In the view at the top, Dart Wantland, geophysicist from the Bureau's Denver office, is connecting one of six geophones (seismic-wave detectors) that are strung out in a straight line from the point where a dynamite blast is to be set off.

The center picture shows Richard Galster, a University of Washington geology student who is getting practical experience during his summer vacation, pushing a plunger to detonate the dynamite charge. The blast creates a miniature artificial earthquake that sends seismic waves through the ground to the geophones. The latter instruments convert the waves into electrical vibrations which are then carried by wires to a 6-element recorder mounted in a seismograph truck.

Both men are seen at the bottom looking at the seismogram (seismographic picture) recorded in the truck. An analysis of this record will enable them to compute the depth to bedrock and to chart a course for the tunnel through sound rock structure so that it can be driven with a minimum of difficulty and expense.

DEVELOPMENT OF CANADA

THE natural resources of Canada, long known to be plentiful, are being proved more varied and extensive all the while, and their development is proceeding at a rapidly accelerating rate. Most recently spotlighted among them are the oil and gas fields of Alberta Province. A boom in drilling, reminiscent of some of the flurries of the past 30 years in the United States, is in full swing there and a huge potential output is already in sight.

But before much of the oil can be put to use, provisions must be made for transporting it to eastern dominion areas where refining facilities are available and markets for finished products are close at hand. A pipe line for this purpose that will terminate at the nearest tip of Lake Superior, 1200 miles distant, has now been built as far as Regina, Saskatchewan. At ceremonies attending the inauguration of the 450-mile stretch last month, Minister of Trade and Commerce Howe called attention to the current rate of growth of the Canadian economy. "This is no country for pessimists," he proclaimed. "Those of us privileged to live in this great land are the most fortunate people on earth."

Mr. Howe was thinking of a great many things. One of them is the wealth of hydroelectric power in Canada. This subject has been dealt with in these pages from time to time and is being covered in a series of articles now running. He also had in mind the enormous stands of timber and the array of plants that has been set up for converting wood into pulp and paper, as well as the fact that Canada is a leading gold producer and the world's foremost source of nickel and asbestos. She has ample coal to meet her needs, and deposits of iron that bid fair to be an important source of supply for U.S. steel mills before many years have passed. Further, in a single mine, she has a sizable share of the world's output of uranium and radium. Under development, likewise, is a great deposit of titanium ore in northern Quebec. Several provinces, notably Quebec, British Columbia, and Manitoba, produce substantial quantities of copper, lead, and zinc.

To this bounteous store of natural wealth that is now being exploited must be added other treasures as yet undisclosed, for new discoveries are announced frequently and great expanses of land remain to be carefully prospected. Bearing in mind that Canada is larger than the continental United States and that her population is only about one-twelfth of ours, it is easy to visualize great prosperity ahead for her. Small wonder that Mr. Howe terms the Dominion no place for pessimists.

MAGIC IN PHOTOGRAPHS

THERE is much in aerial photographs that does not immediately meet the eye. The lens sees things that human vision misses and fortunately records them to be picked out by patient study. Many of them require interpretation, for what they show is often cryptic. Patience and experience, rather than some occult power, are the secrets of accurate interpretation, and almost anyone can, in time, become adept at the art.

Best known, perhaps, is the role that overhead photos play in military operations. They provide a positive check on the results of bombings, and woe betide the crew that waxes extravagant in making claims of hits, for the camera doesn't lie. Less spectacular but more valuable is the wealth of information aerial views offer regarding enemy troop concentrations, gun emplacements, entrenchments, transportation networks, and myriads of other facts that influence the conduct of campaigns.

Geologists and engineers have come to rely in many ways on pictures taken from aloft, and the latter's field of usefulness is continually being widened. One of their first applications was the making of quick surveys in choosing the most direct and easiest-to-build routes for roads through hilly country. The pioneer step was taken just 25 years ago by the Michigan State Highway Department. Faced with the problem of relocating a road in extremely rugged terrain near the village of Beulah, the engineering department foresaw a major job of preliminary surveying.

At that time a young fellow named Ted Abrams was seeking to establish himself as an aerial photographer in Lansing, and someone in the Highway Department thought he might be of help. Following a conference, he was engaged to make a series of shots that could be pieced together into an over-all aerial map. With his photographer, a veteran cameraman of World War I, Abrams took off in a military training plane that was kept aloft by one 90-hp. engine. After three weeks of delays occasioned by bad weather, the skies cleared, the pictures were quickly taken, and proved highly useful. From that beginning, aerial surveying has grown to be established practice in highway departments and is recognized as a quick and inexpensive method of laying out preliminary routes that are later checked by detailed ground surveys.

Geologists have long known that different soils yield distinctive kinds of vegetation each of which registers its individual pattern on photographs taken from overhead, and this has led to the effective use of the camera in locating areas that give promise of harboring mineral deposits. That this art of interpretation can be carried still further is indicated by a news dispatch from Ithaca, N. Y., describing results obtained by Prof. D.J. Belcher of the School of Civil Engineering at Cornell University.

Such a thing as a drainage pipe, for instance, shows up as a thin white line because the filled-in ground is a little drier than that on either side. White spots the size of pin points have been revealed to be anthills, which appear as they do because the ants, in traveling their multitudinous paths around a hill, affect the vegetation sufficiently to make it visible on the photo by its distinctive shading. Faults in the earth that register on pictures have led prospectors to metallic deposits, and the presence of iron is detectable by changes in the colors of leaves. Even diamond "pipes," consisting of blue clay, leave their clues. Proper interpretation of prints discloses areas where the land is dry or wet—where it is or is not feasible to build reclamation projects.

Professor Belcher has divided the rock and earth formations into 30 main categories, which give their distinctive photographic patterns the world over. These are again divided into hundreds of other classifications, all capable of interpretation. A certain kind of soil that has been proved to be suitable for a specific purpose in one locality can be detected in another part of the earth by a skilled photographic interpreter. Anyone of ordinary intelligence can acquire the art, it is claimed.

Professor Belcher put his knowledge of aerial photography at the nation's disposal during the war in Japan. He wrote to General MacArthur's staff, pointing out what could be determined about enemy terrain by painstaking examination of photographs. The response was a message instructing him to lose no time in catching a plane for the Pacific.

This and That

Dry Ice Used by Engineers

The use of dry ice for freezing small areas of unstable ground to permit excavating has been proved practicable in bridge-repair work in the City of Winnipeg, Canada. Placed in a trench around a pier, it froze the adjoining soil solid in about 48 hours, after which excavating could proceed. To reach a depth of 6-7 feet, it was necessary to repeat the process three to four times. The dry ice, delivered in 9- to 10-inch cubes, cost about six cents a pound. Approximately 9000 pounds was needed in repairing defective concrete at the base of one pier of the Elm Park Bridge and cost less, it is reported, than if heavy refrigerating machinery had been brought in. In fact, one of the advantages of dry ice on small jobs is that it eliminates the use of such equipment.

* * *

Tale of a Goat

As a gesture of appreciation for Marshall Plan aid given them, Greek citizens have presented Uncle Sam with a rare zoölogical specimen. The animal is a specie of mountain goat, variously called kri kri, agrimi, and *capra aegagrus cretensis*. It was captured on the Island of Crete by a bearded mountaineer whose name, Eftikios Protopapadakis, makes the goat's sound simple by comparison.

The captor says his quarry was only two days old when caught because no one is agile enough to catch a kri kri that is three days old. The Cretan and his neighbors in the upland village of Apanachori contributed a million drachmas towards the expense of shipping the goat to America. That is a lot of money to them, but only about $66 in United States currency. After a 60-day quarantine period in Athens, the animal was flown here, destined for the Washington Zoo, with Protopapadakis accompanying it to see that it gets nicely settled in its new home.

The agrimi is a special type of antelope revered by the Greeks for the help it supposedly gave their mythological deity, Zeus, when he sorely needed aid. Its likeness is found on pottery dating from prehistoric times, but few persons, even Greeks, have seen a live specimen. The one sent here is the only one in captivity.

* * *

Hazards of British Diggers

Farmers and contractors in Great Britain must be on the lookout for an unusual source of trouble. The prehistoric races that inhabited the islands marked their burial plots with mounds or barrows, and it is illegal to disturb or destroy one of them unless it has first been examined by government representatives.

As reported by the *Muck Shifter*, a British trade magazine, the Ministry of Works points out that "our knowledge of the life and customs of the Bronze Age (about 1900-600 B.C.) is derived almost entirely from the tombs of this period. Though there are thousands of barrows scattered throughout England, Scotland, and Wales, no two of a dozen or so varieties as regards shape and external appearance are alike internally. Thus the destruction of a barrow before an expert record of its contents can be made means an archaeological and historical loss.

"Some barrows are long and cover communal tombs of the New Stone Age (about 2000 B.C.); but the majority, nearly all belonging to the Bronze Age and frequently found on high ground, are round. They are usually between 30 and 90 feet in diameter and seldom more than 6 feet high, though they may be as low as 2 feet."

Most of the barrows that have not yet been studied are on unused land, and it is when these plots are brought under cultivation or included in areas covered by construction works that they are apt to be destroyed. The advent of the bulldozer and other powerful earth-moving machines has added to the danger. A farmer in the west of England recently became liable to prosecution because a contractor employed by him had leveled a barrow while clearing a field that had until then remained untouched. He was therefore subject to a possible maximum fine of $280 or imprisonment for three months.

Many mounds are merely elevated areas that can be cleared away at will. Others that are actually burial places have been classed as ancient monuments. To determine which is which it is necessary to consult the records. Rather than risk getting into difficulties, however, most farmers are careful to give any little hill they encounter a wide berth.

"Hey, Boss, I found the water pipe."

"Ive got an idea what's wrong."

* * *

Britons Cling to Bicycles

With American automobile production at a new peak each month, and city streets literally clogged with cars, we are apt to forget that other means of private transportation are still largely relied upon in some other parts of the world. We are reminded of the continuing importance of bicycles in Great Britain by a recent report on output in that country. If her factories maintain the pace set during the first six months, approximately 3,494,000 complete machines will be produced in 1950, plus parts equivalent to an additional 1,342,000, or a total of 4,836,000 units. During the first half of the year, bicycles valued at more than $30,000,000 were exported.

"We picked him up from the Cleveland Indians."

Jetting Power-Line Poles in Place with Air

POLES carrying power lines are being successfully jetted into water-bearing ground with the aid of compressed air. The method has been used since 1944 by the Alpena Power Company in Michigan and appears to be applicable for setting poles of any type wherever the presence of moisture complicates or precludes doing the job in a more conventional way. An article on Alpena's experience with this novel procedure appeared recently in *The Line*, publication of the Line Material Company, Milwaukee, Wis., and has been drawn upon for the description that follows.

The company operates in Alpena County, located on the shores of Thunder Bay and Lake Huron, and serves 6000 customers with current generated by three hydroelectric stations on the Thunder Bay River. Its first rural distribution line was built across Squaw Bay in 1932 when the level of the Great Lakes system was so low that there was no water in the bay. Holes for the poles were dug in the sandy soil with standard equipment. Subsequently the water level rose, and by 1944 the poles were standing in approximately 2 or 3 feet of water. In the wintertime, the combined action of thick ice and water underneath it loosened the poles and gradually lifted them until they were nearly out of the ground.

When the work of resetting was undertaken, it was found to be impossible to dig in the wet submerged soil, and jetting with water under pressure was undesirable because of the extremely cold weather. In an effort to solve the problem, H.O. Jensen, general superintendent of Alpena, decided to try working the poles back with the aid of compressed air. This method suggested itself to him when he recalled that the company had used a similar procedure in repairing Taintor gates on some of its dams.

A portable compressor was brought out on the ice, the ice cut free from the base of each pole, and a 10-foot length of ¾-inch pipe attached to the end of an air hose and used as a jet. When worked around the lower end of the pole, the latter began to sink, and in less than ten minutes it was 6 feet in the ground. On the strength of this test all the bay-line poles were given this treatment; and to keep them in position, cribbing made up of 12-foot lengths of old poles bolted together was built around the base of each one and filled with stone, sand, and gravel. This work was completed while the bay was frozen and the materials and equipment needed could be trucked out over the ice. Since 1944, subsidence of the water level has bared the lower ends of some of the poles, but those that are still underwater have remained securely in place.

Profiting by this experience, the company again resorted to air jetting in 1945 in constructing a transmission line across swampy land. There was not enough surface water available to use water jets, and under similar conditions the crews for some years past had been setting poles by digging through barrels. This procedure was slow and costly, especially as barrels were not plentiful and commanded anywhere from 50 cents to $4 each. Glenn Burns, assistant superintendent in charge of distribution, reasoned that the air jet would penetrate the water-laden ground lying just below the surface, and a little experimenting proved that he was correct.

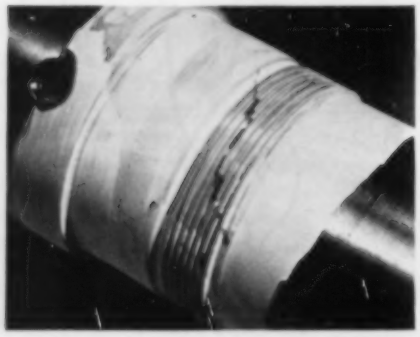
Sod and top soil were removed to ground-water level, usually about 2 feet deep. The pole was then raised and held upright while compressed air was introduced around its base. It was found that the poles could be worked into the ground at increased speed by rocking them, especially where gravel or boulders were present. Once the 5-man crew got accustomed to the method, it was able to set a pole and move the equipment on to the next site in approximately 25 minutes.

As a result of these operations, air-jetting is now standard practice with the Alpena Power Company wherever soil conditions are favorable. Although water-jetting is successful where sufficient water is available, air-jetting is preferable in well-nigh all cases where the ground is too wet for digging. The air jet is easily the most practicable of the two under winter conditions, and at all times has the advantages of being quick, dry, clean, and simple.

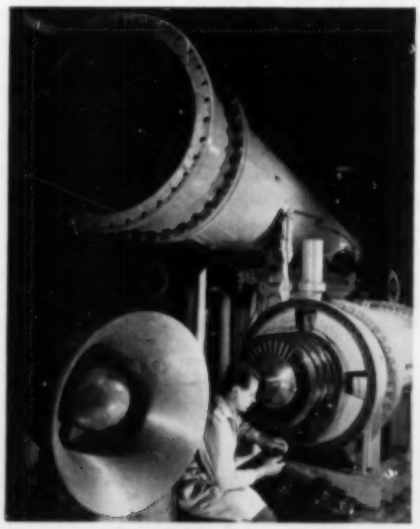
In the past, the company has sometimes set poles in wet locations with the aid of dynamite. But that is not wholly satisfactory, and explosives cannot be used safely in built-up areas. Another objection to them is that they often damage the butt of the pole. In any event, the method takes longer and is more hazardous than air or water jeting, either of which enables a crew to maintain close control of the pole at all times.

Red Stains Disclose Flaws in Metal

A NEW method of inspecting metals that reveals cracks or other surficial defects too small to be seen even with a magnifying glass has been developed by the Turbodyne Corporation, a subsidiary of Northrop Aircraft, Inc., Hawthorne, Calif. It is applicable to either ferrous or nonferrous metals and is claimed to be simpler, less expensive, and more accurate than other means used for the same purpose. Only simple equipment is required, and any part of a machine that can be seen and reached can be tested in place. One of the main fields of service is expected to be the checking of welds for soundness.



Called Dy-Chek, the method involves the use of a special scarlet dye that is applied to the part to be examined by brushing, spraying, or dipping. After drying for five minutes, the stain is wiped off with a cleaner fluid and a white "developer" solution is put on. If there are any flaws in the metal they will then be marked by fine red lines or dots. The picture shows cracks in part of a crankshaft that could have caused a serious breakdown if they had gone undetected.



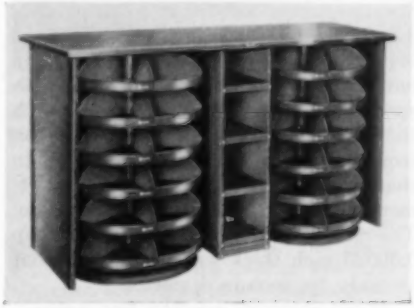
JET-ENGINE TESTER

A newly designed compressor rotor for an airplane jet engine is shown being made ready for tests in a low-speed wind tunnel at the Aviation Gas Turbine Division of Westinghouse Electric Corporation in South Philadelphia, Pa. The device at the left, which resembles a loud-speaker, is swung around to supply air to the rotor, which is driven by an electric motor mounted inside the tunnel. The low-speed tunnel imposes little strain on parts being tested and enables engineers to make quick design changes. Other tunnels in the laboratory simulate actual operating speeds and temperatures of highly stressed jet-engine parts.

Industrial Notes

According to an announcement by the General Electric Company, zinc is being made as strong as brass by the addition of small quantities of copper and beryllium. The alloy, named Zncube, is said to have the same electrical properties as brass and to cost considerably less.

Designed for easy aisle access and space saving, the combination storage bin and counter shown in the accompanying illustration has 72 sizable com-



partments in twelve trays, together with four stationary compartments. Each tray is 28 inches in diameter and rotates independently. Called Rotabin Counter, the unit is more than 6 feet long, 27 inches deep, and about 41 inches high. It is made by The Frick-Gallagher Manufacturing Company and is finished in olive-green enamel.

Something different in a drying and polishing material for metal, plastic, rubber, wood, glass, and other parts that do not exceed the size limit of a tumbling barrel has been announced by Kube Kut, Incorporated. The new medium is composed of seasoned hardwood (maple) in cube form to which macerated corncobs are added, both being screened and aspirated thoroughly to remove dust. A variety of mixtures and particle sizes are available to meet specific requirements. The advantage of Korn-Kube, as the material is called, is that it combines the high absorptive properties of sawdust with the tougher polishing action of pulverized corncobs.

Two new synthetic lubricants—Gulf Special Instrument Oil and Gulf Micro Bearing Oil—have been introduced by the Gulf Oil Corporation. They are the result of years of effort by the Elgin National Watch Company, in coöperation with the Mellon Institute and the Gulf Research & Development Company, to find a perfect watch oil. Both are especially suitable for lubricating small, delicate, low-torque bearings in precision instruments and have virtually none of the ordinarily desirable creeping or spreading tendencies of conventional petroleum oils. This nonspreading quality enables them to "stay put" for long periods when applied in minute quantities to pivot-to-jewel or pivot-to-brass bearings. They are also said to combine high resistance to oxidation with exceptionally low volatility, properties that minimize gumming or thickening.

By means of a hydraulic locking device actuated by a hydro-pneumatic accumulator it is possible, according to W. E. Richcrook of the Minister Machine Company, to lock pneumatic die cushions at the bottom of the stroke when doing deep drawwork. The purpose of the device is to prevent damaging finished parts during the stripping operation. Through its use, the die cushion is released only when the slide or ram of the press has reached a point on the upstroke at which the drawn work is completely clear of the upper half of the die when ejected by the lower half. Both locking action and release are controlled by a rotary limit switch operated by the crank of the press.

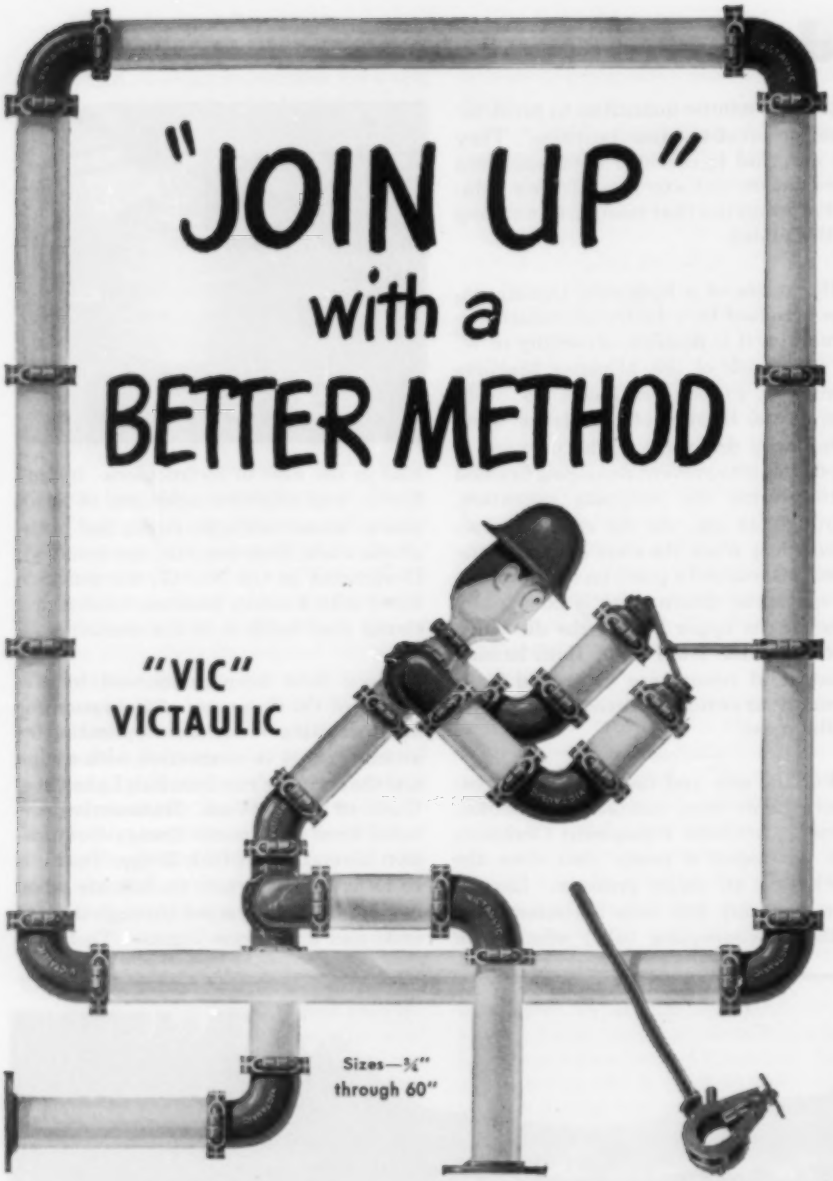
For the safe and fast transfer of corrosive fluids from stainless-steel drums, General Scientific Equipment Company has developed a pump that does the work with air under pressure. Liquids flow smoothly and come in contact only with the connecting tube, which is of

lead in the case of hydrochloric, hydrofluoric, and sulphuric acids and of saran plastic where muriatic, citric, and phosphoric acids, bleaches, etc., are involved. Designated as GS No. 17, the pump is fitted with a safety pressure valve and a clamp that holds it in the container.

Plans have been announced by the Standard Oil Company of California for an interesting industrial application of atomic energy in connection with a pipe line that is being run from Salt Lake City, Utah, to Pasco, Wash. Radioactive material from the Atomic Energy Commission laboratory at Oak Ridge, Tenn., is to be used as a tracer to indicate when one grade of oil pumped through the line ends and a new one begins. To be ex-

THIS WAS A RIVER BED

Few persons other than dam builders ever get a good look at the bottom of a river. Naturally some of them are rougher than others, and here's one that's really rough. It is the bed of a stretch of the Ottawa River in Canada where there were rapids before the stream was diverted to build the Des Joachims dam and powerhouse described in our October issue. This section is now the tailrace carrying water from the hydroelectric turbines. Before the area could be excavated by putting in blast holes with wagon drills and Quarrymasters, the large boulders had to be blockholed with Jackhamers and the surface generally made smooth. The logs were originally destined for pulp mills downstream and seem to have been trapped when the river was turned into another channel.



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PIPE COUPLINGS AND FITTINGS

plicit, whenever the Salt Lake pumping plant changes over from one product to another, a fraction of an ounce of tracer liquid will be injected into the oil stream, forming what might be called a barrier between the two and moving along with them. As soon as the radioactive fluid reaches a delivery point in the line, sensitive instruments with a Geiger counter attached to the pipe will respond to the tracer and tell the operator when it is time to switch the incoming oil from one tank to another.

Unbelievable though it may seem, the research laboratory of Armco Steel Corporation has succeeded in reducing steel strip to such a thinness that it takes ten layers to equal the thickness of a human hair! Need for a superthin alloy with special magnetic properties arose with the development of high-frequency electronic equipment, and manufacturers in that field and the U. S. Navy Department turned the problem over to Armco. The result is a mill which produces strip 0.00025 inch thick with work rolls that are only 5/16 inch in diameter.

Open-hearth furnace slag is a potential source of manganese, according to Sylvester & Company, which has developed a process for the extraction of this vitally needed alloying agent from the dumps that have been piling up around steel mills for years. Plans are underway for the construction of a plant in Youngs-

ARTICULATE GOLF BALL

Lawson Little, prominent professional golfer, listens through the earphones of a Geiger counter to signals coming from a golf ball that contains a minute quantity of radioactive material. Holding the ball is its originator, Dr. William L. Davidson, director of physical research of The B. F. Goodrich Company. This offshoot of developments in atomic energy may eventually enable the nation's golfers to recover most of the estimated twelve million balls lost annually in deep grass and woods of playing courses. Experiments with the new balls are continuing, but they are not yet on sale.

IMPROVED CHERRY PITTER

The cylinder in the background contains 700 rubber cups, into which cherries are fed by a conveyor belt. As the drum turns forward, pins punch the pits out and through holes in the bottoms of the cups. The stones are carried off by a stream of water and the pitted cherries fall on the belt in the foreground for sorting prior to further processing and packing. Machine can pit 1000 pounds of fruit per hour. For maraschino cherries alone, it promises to save the industry $3,000,000 annually by speeding up the operation and cutting waste by 9 percent. All canned cherries may be similarly pitted in the future. The cup idea was conceived by the United States Rubber Company.

town, Ohio, by Ohio Manganese Company, Inc., which has been granted a license to use the method. The concern has an option on slag that has accumulated at a Youngstown steel mill and expects to treat about 250 tons a day. The cost of recovery is said to be high, but warranted because of the scarcity of this basic mineral in the United States. Only slag with a manganese content of at least 4 percent can be processed profitably.

New developments and new problems seem to go hand in hand. Take, for example, jet planes, which use a kerosene-type fuel instead of high-octane gasoline. Unlike the latter, it has a low rate of evaporation and, if spilled on airfield runways, attacks the bituminous paving, eventually stripping it down to the aggregates. Exposed to the terrific rear-end blasts of the jets, these loose, hard fragments may also do a lot of damage if blown into the air intakes of following planes. A rubber surfacing material that may solve the difficulty is being tried at the government Wright-Patterson Field in Dayton, Ohio. Produced by the United States Rubber Company, it is a solvent-resistant rubber compound which is mixed with tar to produce a durable surface that is said to withstand the harmful effect of kerosene. Called Aero-Sealz, it may find application also as a filler between concrete runway and highway slabs.

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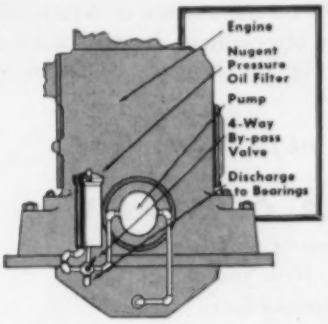
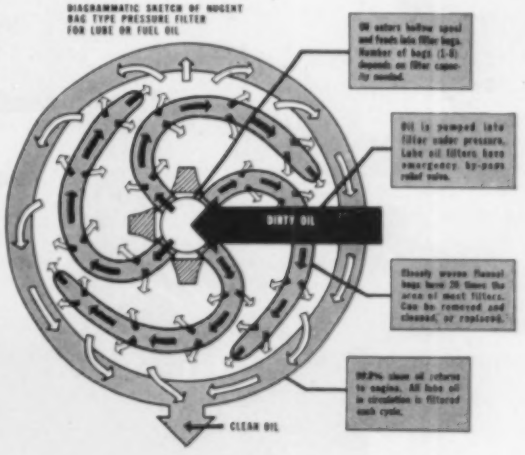


Further, Nugent bag-type lube and fuel oil filters with expendable bags have 20 times more filtering area than other filters of comparable size. Using a Nugent filter, you'll be able to clean more oil per hour, with fewer changes of filter elements. This is particularly important in full-flow systems, where all the oil in circulation each cycle is being cleaned.

The illustration above shows a Nugent full-flow filtering system. Note that the oil is handled by the engine oil pump—no other pump is needed. Filtering systems of this kind are ready for power equipment of any size. Ask a Nugent engineer to give you full details.

The diagrammatic view below shows the tremendous filtering surface of a Nugent bag-type pressure filter. The bag, designed to be used and discarded, is made of a closely woven lintless material which removes particles as small as a few microns and delivers oil 99.8 per cent clean. This type of filter is ideal for filtering all the lube oil in circulation every cycle before the oil goes to the bearings, thereby removing the dirt as soon as it gets in the oil, and retarding the formation of sludge and acidity. The dirt-filled bags are easily removed without tools, and are inexpensively replaced.



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Adv. 21 (258)

Books and Industrial Literature

The Federal Government now permits employers to combine Social Security and witholding taxes in deducting them from payrolls. As there are about three-thousand million deduction entries involved in computing a year's payrolls in America, the significance of any simplification such as this is apparent. To minimize accounting procedure, charts that show this combined deduction as applied to weekly and monthly earnings of various amounts have been issued by Delbridge Calculating Systems, Inc., 2502-10 Sutton Avenue, St. Louis 17, Mo. Their use, it is claimed, reduces computing time by 46 percent. Price, $7.50 for weekly payroll period, $10 for monthly payroll period.

A book designed for the technical man concerned with any gasification process has been written by William Gumz, consultant at the Battelle Memorial Institute, Columbus, Ohio. Inasmuch as gasification of solid fuels is just ahead of us and many improvements are being made in the technology of reducing iron ores the appearance of this volume is well-timed. Its major purpose is to explain the theory involved in the reactions of gasification and to present calculating methods that will save time for the development engineer by rendering many experiments unnecessary. Titled *Gas Producers and Blast Furnaces*, this 311-page book is published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N.Y. Price, $7.00.

Engineers charged with the responsibility of keeping industrial-plant machinery and equipment in fit operating condition should welcome *Plant Engineering Handbook*, just published by McGraw-Hill Book Company, 330 West 42nd Street, New York, N.Y. Edited by William Staniar, formerly mechanical power engineer for E.I. du Pont de Nemours & Company, it combines information under 76 major categories on plant organization, design, construction, operation, and maintenance. Eighty-seven authorities from five universities and 45 leading industrial organizations contributed to its nearly 2000 pages. All information is arranged for easy reference and includes tables, formulas, and graphs. The chapter on compressors and pumps was prepared by A.W. Loomis, assistant editor of this magazine. Price, $15.00.

A 28-page illustrated catalogue on new developments in exhibiting and controlling flow instruments for all industries is offered by Fischer & Porter Company, Hatboro, Pa.

Wheelco Instruments Company, 847 W. Harrison Street, Chicago 7, Ill., has available for free distribution a bulletin on its new potentiometer controller—the Potentiotrol—which operates with an electronic link.

By writing to the Weatherhead Company, 300 E. 131st Street, Cleveland 8, Ohio, you can get a 3-pocket portfolio containing the latest catalogues on its line of industrial hose, hose ends, and tube fittings. H-1451 deals with reusable steel hose ends and industrial hose; E-1457 with Ermeto-steel and stainless-steel fittings; and F-1456 with industrial tube and pipe fittings.

Air-operated vibrators, valves, and fittings for shaking and settling materials are described and illustrated in a 12-page catalogue released by the Cleveland Vibrator Company, 2756 Clinton Avenue, Cleveland

13, Ohio. Publication also tells how the vibrators operate and lists the many functions they perform. When writing for a copy ask for Catalogue No. 105.

Charles L. Jarvis Company, Middletown, Conn., has added to its line of power tools a full set of precision-ground tungsten-carbide rotary files, reamers, end mills, boring bits, and knurls. They are described and illustrated in a 12-page, 2-color folder.

Metalweld, Inc., 26th and Hunting Park Avenue, Philadelphia 29, Pa., offers a bulletin that describes and illustrates representative applications of the metalizing process in making mechanical repairs and protecting surfaces against corrosion and contamination.

An 8-page folder, Bulletin V, describes direct-operated solenoid valves for automatic or remote flow control of liquids and steam up to 400°F., and of high-viscosity liquids at pressures up to 150 psi. Obtainable from The Johnson Corporation, Three Rivers, Mich.

B.F. Goodrich Company claims that vibration from machinery can be reduced as much as 75 percent by use of its Vibropad, which consists of a 12x12-inch rubber pad with tubes and snubbers. The equipment is described in Catalogue Section 7290, obtainable from the company at Akron, Ohio.

Of interest to tool and die makers and production shops is a colored folder on the Micro Grinder designed for wet or dry grinding of punches, dies, gauges, special shapes, and extra large parts. Available from Sanford Manufacturing Company, 1020-35 Commerce Ave., Union, N. J.

Ortman-Miller Machine Company, Inc., Hammond, Ind., offers cost-free templates for design engineers who contemplate using its air or hydraulic cylinders in assemblies. The paper template is slipped into position beneath the designer's tracing cloth or paper and the required component parts are traced off.

Scaffolding composed of standard steel pipe assembled with the aid of three patented fittings is described in a bulletin issued by Amidon Sales Company, Box 61, Elyria, Ohio. Such scaffolds, it is claimed, can be built up to any height and in the size and shape required for a specific construction or maintenance job.

Calling filing cases the "memory and nerves" of a business organization, Remington Rand Inc., 315 Fourth Ave., New York 10, N.Y., has made a comprehensive study of filing and published the results in a handbook, *A Yardstick of Filing Cost and Efficiency*, that can be obtained by writing to F.J. Hastings at the address given.

Bulletin 102 of The C.E. Squires Company, 18502 Syracuse Ave., Cleveland 10, Ohio, describes that firm's Class "H" pressure regulator and pump governor. The device is a simply designed valve suitable for service where close regulation of a pilot-operated valve is not necessary. In addition, it can be used as a pump governor.

Complete information on Logan air-control valves is given in a revised edition of Catalogue 100, Section 4, published by the Logansport Machine Company, Inc., Logansport, Ind. Functions and dimensions of each model are given, six pages are devoted to detailed working data on the various classifications of valves, and sixteen schematic diagrams show typical applications.

NAYLOR PIPE PUTS A RIVER "IN ITS PLACE"

When a river gets out of bounds and seepage interferes with tunnel construction, it's time to put Naylor Pipe to work.

The picture shows how contractors in the mountains of Mexico are using this distinctive light-weight pipe to rid the tunnel of water and keep the river where it belongs.

Whether you need water lines, air lines, ventilating lines, cement pumping pipe, dredging lines or other applications, it will pay you to take advantage of Naylor—the light-weight pipe with the heavy-weight performance.

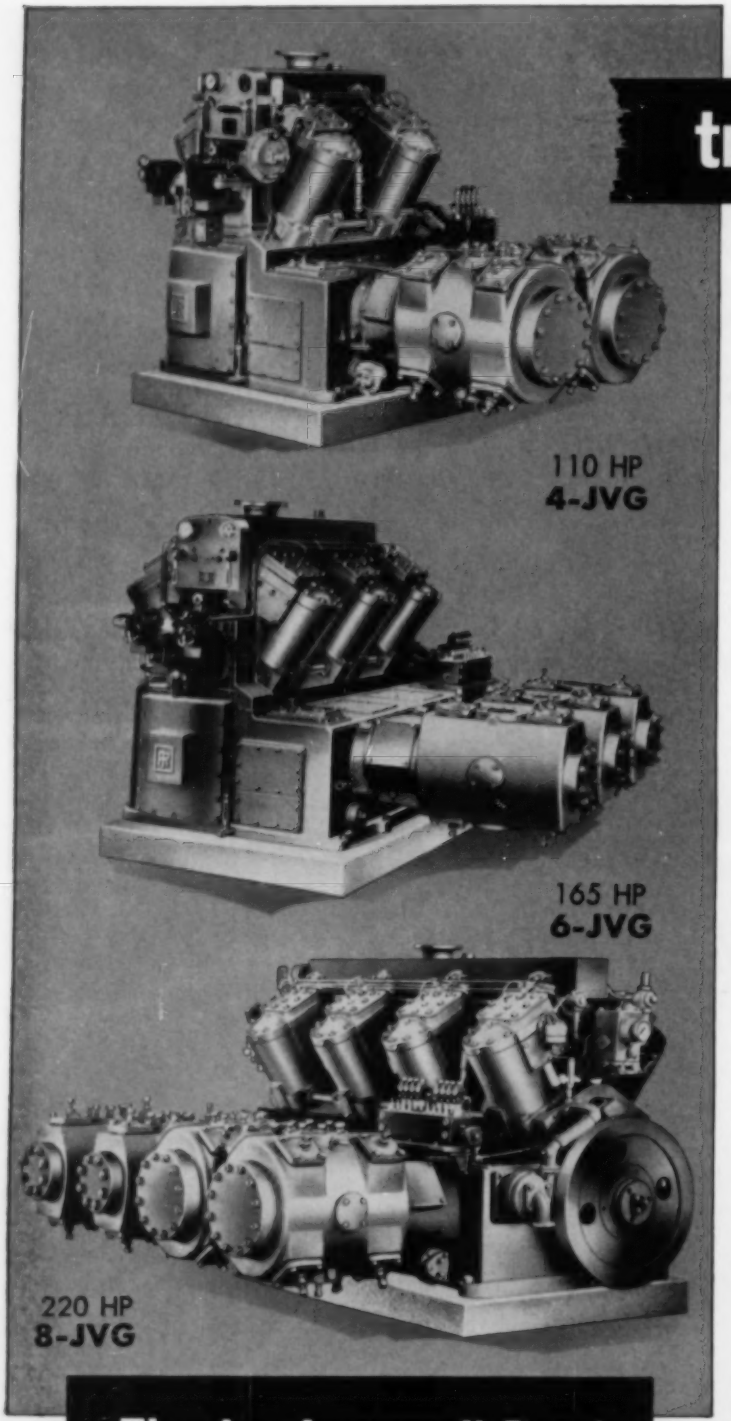
Sizes from 4" to 30" in diameter with all types of fittings and connections.

Write for catalog No. 44.

NAYLOR PIPE COMPANY

1245 East 92nd Street, Chicago 19, Illinois

New York Office: 350 Madison Avenue, New York 17, N. Y.



try these for size

...and economy!
...and performance!

The light-weight, gas-engine-driven JVG is now available in three sizes . . . 110, 165, and 220 horsepower . . . for refinery or oil field service. Excellent running balance of these Ingersoll-Rand 4-cycle V-angle compressors, needing only small foundations, makes them ideal for skid mounting and jobs where frequent relocation is necessary.

The JVG is designed for maximum flexibility of loading, to meet any pressure conditions . . . any gas . . . any service. Maintenance men and operators praise its heavy-duty construction, economy of fuel and lube oil, and simplicity and compactness. They also like the perfect combustion and smooth, quiet 4-cycle operation under all load and speed conditions.

These units will meet your most exacting specifications for high efficiency, conservative rating, long life and low maintenance . . . whether the job be for semi-portable use or permanent installation. Consult your nearest I-R representative for complete details.

Horsepower	Width	Length	Height
110	6'-2"	8'-5"	6'-3"
165	8'-3"	8'-5"	6'-3"
220	10'-4"	8'-5"	6'-3"

They're Ingersoll-Rand
JVG
GAS-ENGINE-DRIVEN
COMPRESSORS

4-CYCLE V

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

Types XVG, SVG and KVG gas-engine-driven compressors are available for installations requiring larger horsepower ratings.

522-6

COMPRESSORS • AIR TOOLS • CONDENSERS • ROCK DRILLS • TURBO BLOWERS • CENTRIFUGAL PUMPS • OIL & GAS ENGINES

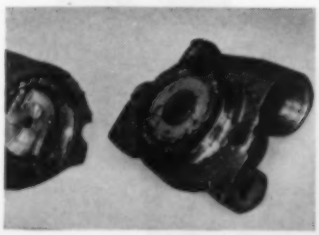
Air hose with cover and tube of NEOPRENE built for trouble-free service in strip mines

Strip mining is tough on air hose But here's a kind you can hook up and forget. It's made to stand up under the worst operating conditions . . . protected both inside and out with tough, durable neoprene.

The cover of neoprene withstands exposure to sunlight, ozone, heat and oil . . . doesn't crack or soften. Because of this, it remains tough and durable—resists abrasion and cutting—long after these conditions have weakened ordinary rubber hose to the point where it fails.

The neoprene tube won't disintegrate when exposed to lubricating oil. So no crumbled particles or chunks will be carried along to clog tools. And because neoprene retains it strength and toughness, it constantly protects the fabric reinforcement from oil, heat and moisture which rot the fabric and lead to blowouts.

Next time you buy air hose, make sure it's set for long, trouble-free service life. Make sure it's made with neoprene cover and tube E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division, Wilmington 98, Del.



NEOPRENE PREVENTS TROUBLE LIKE THIS!

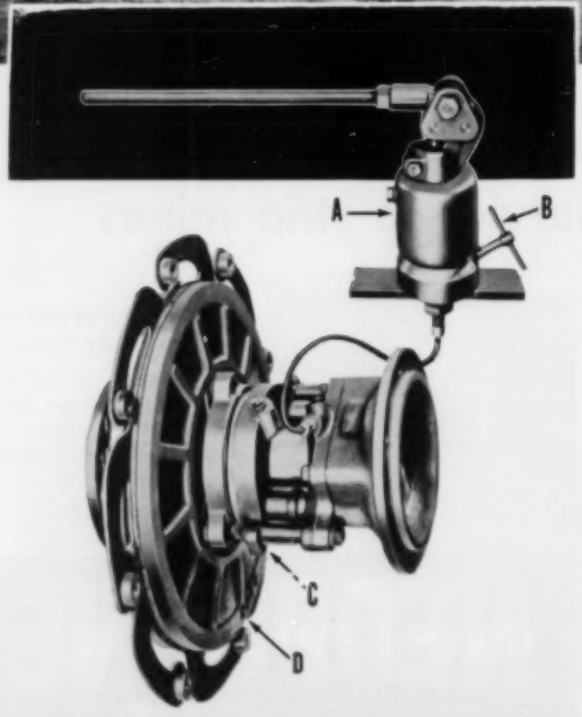
Jackhammer, partially dismantled, shows accumulation of disintegrated hose which has almost clogged up air ports in the valve and rifle bar assembly.

NEOPRENE

The rubber made by Du Pont since 1932

DU PONT

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY



Building Haul Roads Takes Tough Equipment

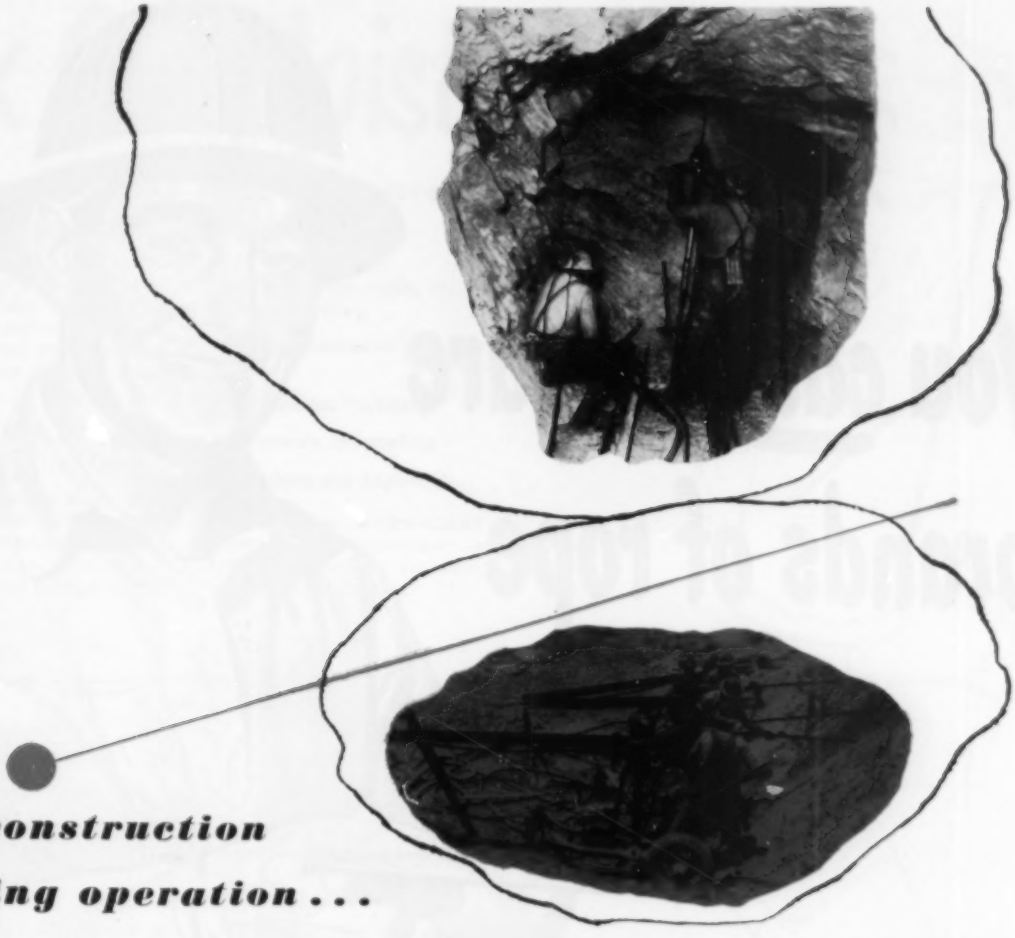
To supply the demands of a lively construction market, the lumbermen are going after the timber in the less accessible locations.

This K-500 *Mobil-Air* Compressor is helping to build a truck haul road for getting timber out of Potlatch Forest near Boville, Idaho. Its *Flex-Disc* Clutch with *Hydro-Shifter* enables it to operate freely in heat or cold at any altitude.

The *Flex-Disc* Clutch (D at left) meets the exacting requirements of portable compressor duty. Finger-tip hydraulic control is provided by the pump reservoir and handle (A) for disengaging, and the release valve (B) for engaging the clutch through the hydraulic jack unit (C). All parts are built for low maintenance and long service. The seldom needed replacements are readily made without disturbing the rest of the compressor.

INDUSTRIAL CLUTCH CORPORATION

Waukesha Wisconsin



in every construction drilling operation . . .

CRUCIBLE HOLLOW DRILL STEEL

cuts costs

In mines and quarries, roads and tunnels Crucible Hollow Drill Steel is giving users *lower cost per foot drilled*. Controlled hardenability, excellence of stress-bearing surfaces and uniform processing all contribute to the assurance that Crucible Hollow Drill Steel will cut costs in your drilling operation.

To make these economies more than just a promise . . . *every lot* of Crucible Hollow Drill Steel is *pretested*. Crucible's drilling tests *before* the steel is shipped is another reason why you can count on Crucible to deliver the drill steel you need to keep your costs down!

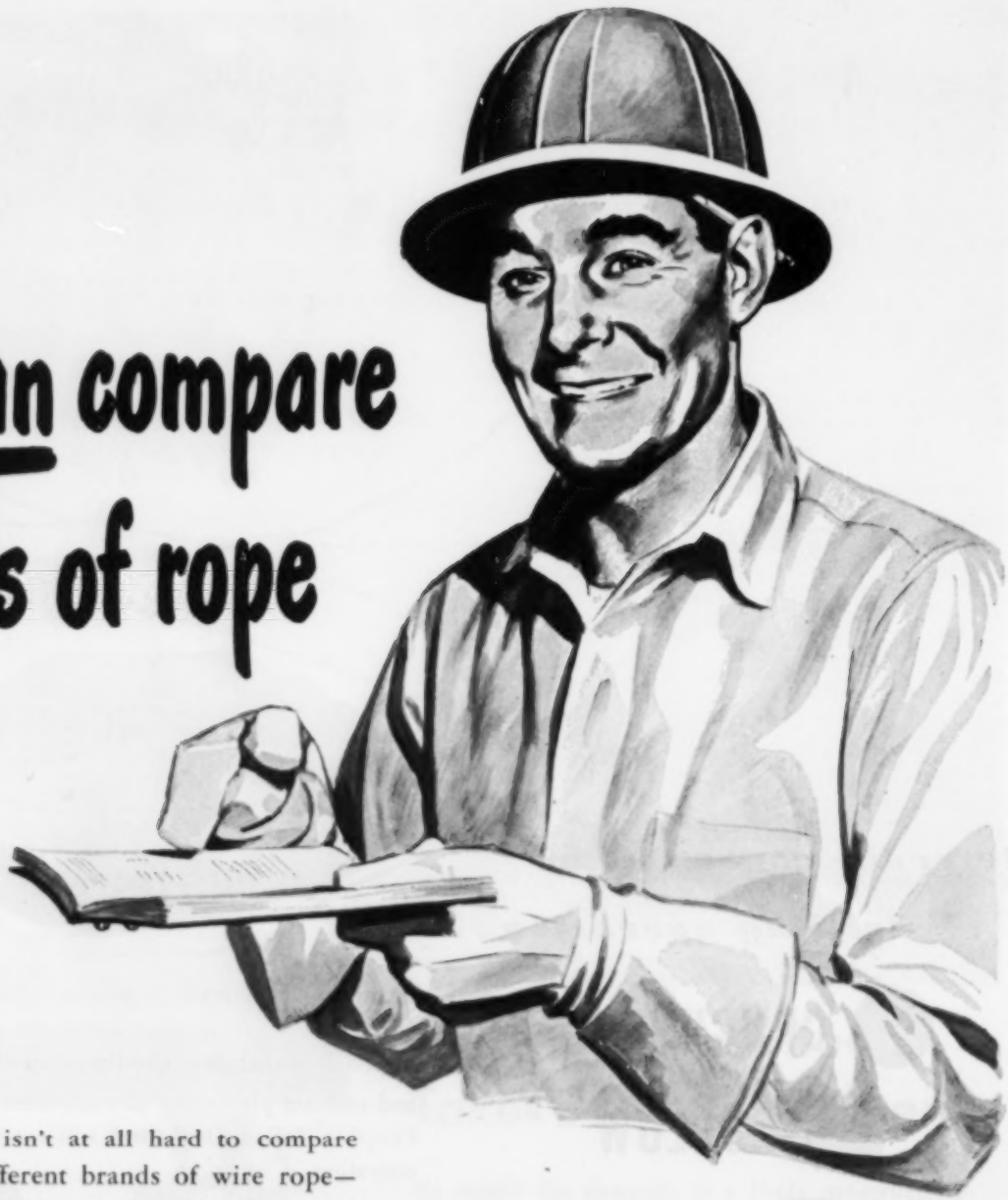
So, when you ask for CRUCIBLE, you know that lot after lot is produced to chemical uniformity—proven by performance under field conditions. What's more you get fast field service, alert metallurgical advice, countrywide stocks. Check our local representative, he can help you. CRUCIBLE STEEL COMPANY OF AMERICA, Chrysler Building, New York 17, N. Y.

CRUCIBLE first name in special purpose steels

HOLLOW DRILL STEEL

HIGH SPEED • TOOL • STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE • STEELS

You can compare brands of rope



It isn't at all hard to compare different brands of wire rope—not if you keep a simple system of records.

These records should, of course, show the work totals done by your wire ropes during their lifetime. Pick as a basis the unit of work most applicable to your line of business—a ton-mile, for instance, in oil-country drilling; a cubic yard of rock moved; a car of coal hauled up a slope, etc. When the ropes have finally been retired from service, see how much—or how little—their cost has been per unit of work.

Bethlehem has always advocated the keeping of such records. One reason (we admit it freely) is that Bethlehem wire rope is an *economical* rope, and your records will prove it. We welcome comparisons with anybody's product.

LET YOUR RECORDS TELL YOU!

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

Export Distributor: Bethlehem Steel Export Corporation

Knock Out Moisture

before it knocks your air-operated equipment out of whack

Assure the satisfactory performance of air-operated instruments. Prolong the life of pneumatic tools and air-operated instruments. Use Cuno MICRO-KLEAN Filters to remove moisture from compressed air.

MICRO-KLEAN Gets *All* the Moisture and the Dirt, Too

Used on such equipment as spray systems, automatic control instruments, air hoists—wherever compressed air is used—Cuno MICRO-KLEAN removes *all* entrained moisture *plus* foreign particles (dirt, pipe scale, etc.) down to 1 micron in size.

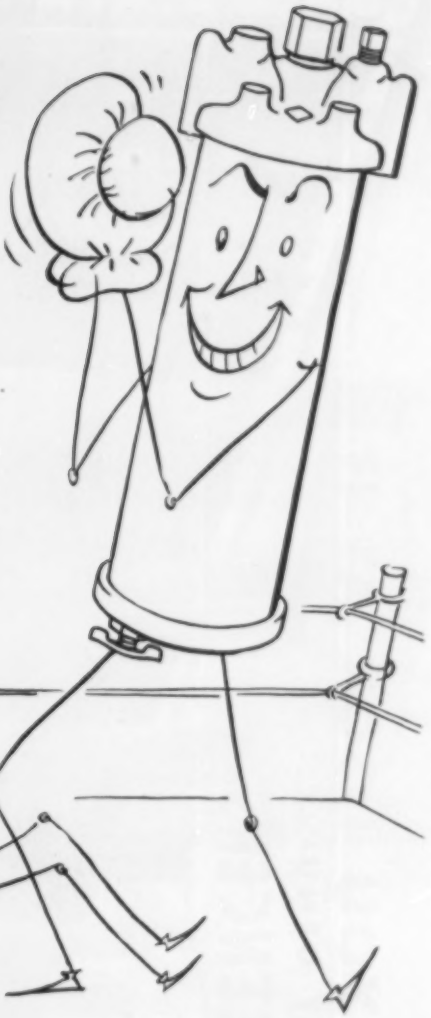
Cuno's exclusive cartridge construction—

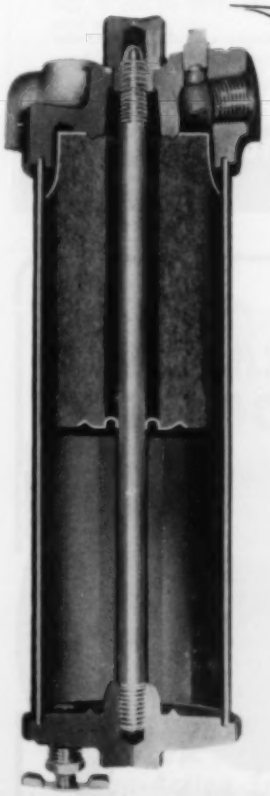
1. eliminates "wicking"

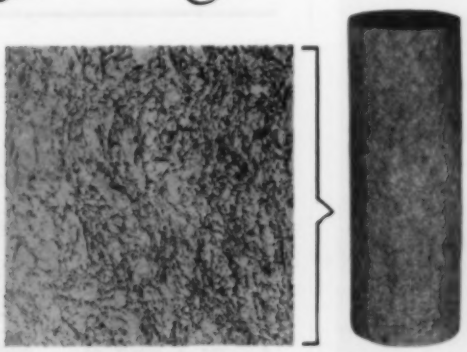
2. prevents channeling

3. doubles dirt capacity

Test Cuno MICRO-KLEAN Air Line Filter on your equipment—and see how trouble caused by entrained moisture and dirt disappears.







How Cuno KO's Vapor

Air passing into filter hits baffle, which deflects some moisture down outside cartridge. Any moisture remaining enters cartridge where it must work its way through a network of tiny interstices, making hundreds of sharp turns and impinging, sooner or later, on non-wicking fibres. Then it drains into the extra-large collection chamber.

No Fluid Is Better Than Its Filtration

CUNO

Complete Line

Fluid Conditioning

Removes More Sizes of Solids from More Types of Fluids

MICRONIC (Micro-Klean) • DISC-TYPE (Auto-Klean)
WIRE-WOUND (Flo-Klean)

Find out how little it costs to MICRO-KLEAN Your Compressed Air

- ☐ Air Hoists
- ☐ Pneumatic Tools
- ☐ Sand Blast Equipment
- ☐ Spray Paint Lines
- ☐ Air Guns
- ☐ Racking and Bottling Equipment
- ☐ Air Operated Instruments
- ☐ Air Operated Vulcanizing Changers
- ☐ Air Operated Presses
- ☐ Air Brake Systems
- ☐ Compressor Suction Unloaders
- ☐ Air Operated Cotton Pickers
- ☐ Air Operated Glass Blowing Equipment
- ☐ Air Operations for cleaning and testing rubber goods
- ☐ Liquid Agitators

Any other compressed air service.....

Any other gas.....

CUNO ENGINEERING CORPORATION
1720 South Vine Street, Meriden, Conn.

Please send me a free copy of your MICRO-KLEAN Air Line Filter Bulletin. I am especially interested in the services checked.

Name.....Title.....

Company.....

Address.....

City.....State.....

PLEASE ATTACH COUPON TO YOUR BUSINESS LETTERHEAD

NO MATTER HOW YOU LOOK AT IT
YOU CAN'T BEAT GENUINE
MAXIM SILENCERS

Please send literature on the following silencers:
☐ exhaust ☐ intake
☐ spark arrester ☐ steam blow-off
☐ heat recovery

Name_____
Company_____
Address_____

THE MAXIM SILENCER COMPANY
61 HOMESTEAD AVE. • HARTFORD 1, CONN.

12MXBO

This WISCONSIN-POWERED Mobile Compressor GOES TO THE JOB

4-cycle Single Cylinder 6 to 9 hp.

This Wisconsin-powered Ingersoll-Rand Model J-10 and Pac-Air unit is demonstrating its versatility in connection with the installation of machinery in a large printing plant. It GOES directly to the job, inside or outside, and stays with the job until it's finished.

Whether your need is for thoroughly dependable engine power components on original equipment of your own manufacture, or for effective utilization of such power on a direct service basis, there are many good reasons why Wisconsin Engines rate your preference. Heavy-duty construction features, plus highly efficient air-cooling, compactness, light weight and easy starting in any weather are points worth weighing and acting upon.

The Wisconsin line includes 4-cycle single cylinder, 2-cylinder and V-type 4-cylinder models in a complete power range from 3 to 30 hp. Detailed data on request.

MOST H.P. HOURS

WISCONSIN MOTOR CORPORATION
World's Largest Builders of Heavy-Duty Air-Cooled Engines
MILWAUKEE 46 WISCONSIN

Nicholson Air Traps Assure

POSITIVE DRAINAGE OF AFTERCOOLERS

by 2 Advanced Features

MODEL JR

1) Positive Fluid Seal Over Discharge Valve—As a result of this feature Nicholson traps are increasingly specified wherever loss of air is a problem in drainage of aftercoolers, intercoolers, separators, receivers, etc.

2) Extra Large Discharge Capacity—Valve opens wide instantaneously to discharge water, oil and dirt, after which it closes tight—instantaneously.

OTHER TROUBLE-PROOF FEATURES Non-wire drawing; not dependent on float to raise valve; of stainless steel where it counts, to prevent corrosion; rugged, for unavoidable abuse. 3 types for press. to 1500 lbs.

Catalog 448 or see Sweet's

W. H. NICHOLSON & CO. 180 OREGON STREET WILKES-BARRE, PA.

Valves • Traps ★ Steam Specialties

SAUERMAN

Power Drag Scrapers

Picture shows a small Sauerman Crescent Scraper (1½ cu. yd.) reclaiming slaked lime from a huge waste pile to a portable processing plant. The scraper cuts through the outer crust and moves about 300 tons of the sticky material a day.

A Sauerman Scraper can reach across a pit, pond, bank or stockpile and move material at high speed from one point to another anywhere within its wide radius of operation. Any mechanic can operate it. Upkeep is simple. Sturdy construction for long service. Bucket sizes from ⅓ to 15 cu. yd., spans range up to 1000 ft.

These machines are backed by over 40 years of experience in designing this type of equipment. Whether it is an installation to handle a hundred tons, or many thousand tons per day, it will be efficient, economical and easily operated by one man.

Write for our new Scraper Catalog

SAUERMAN BROS., INC.
548 S. Clinton St., Chicago 7

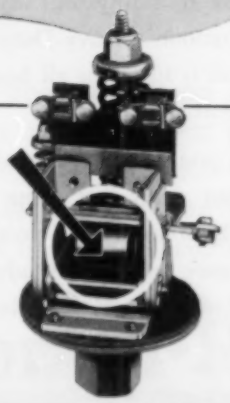
Pressure Switch

FOR **AIR COMPRESSORS** AND **WATER PUMPS**

CLASS
9013 • TYPES GHG and GSG

"POWER HOUSE"
Snap-Action Spring

provides powerful contact snap action and complete valve opening with air compressor switches at all ranges of operation—40 lbs. through 200 lbs. P.S.I.



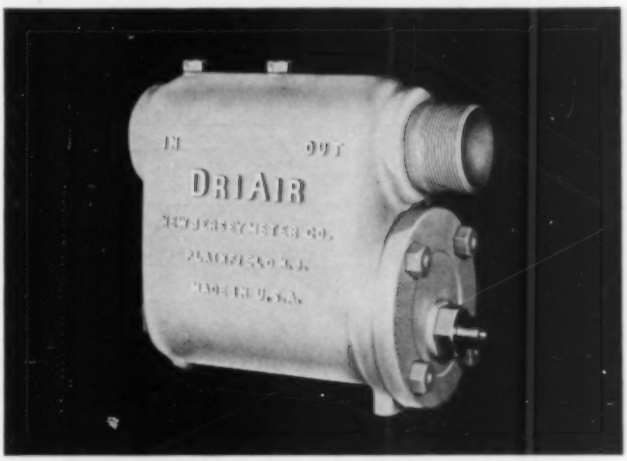
Write for Bulletin **9013-G**

Square D Company, 4041 N. Richards St.
Milwaukee 12, Wisconsin

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

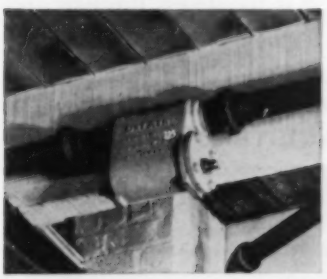
DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

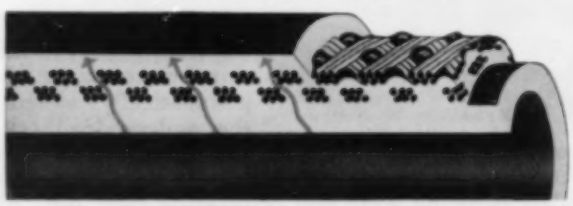
PLAINFIELD, NEW JERSEY

TOUGHER–from tube to cover

Condor Homoflex HEAVY-DUTY AIR HOSE

No other hose construction equals Condor Homoflex HEAVY-DUTY AIR HOSE for *flexibility* and *ability to cushion shock*. It's not just a matter of an extra thick cover to withstand the gouges of rock and the abrasion of dragging over rough terrain. Homoflex "toughness" is more than cover-deep; it is toughness through and through.

HOMOGENEOUS FLEXLASTICS "THROUGH-AND-THROUGH"



The enlarged cross-section illustration of the Homoflex Hose wall shows how the cover, strength member, and tube are "fused" into one homogeneous unit. You can't separate any part of this hose from another. It is this construction, with all the sinewy resilience of its strength member embedded in Flexlastics that makes possible lighter weight, extreme flexibility and resistance to kinking, with no sacrifice of safe working pressure.

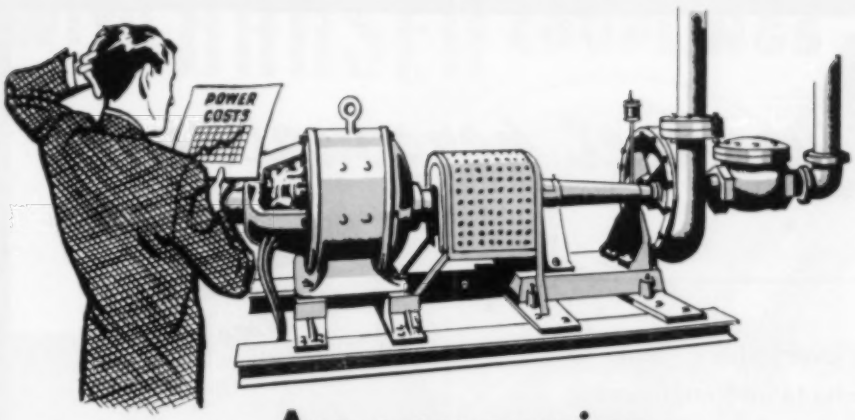
Contractors, quarries and mines have long called for better and more flexible hose to take the abuse of falling rock, sharp bends and rough handling. They can't "baby" hose. If it doesn't stand up, it is sometimes a risk to safety and always costly to replace. Condor Homoflex Heavy-Duty Air Hose has an oilproof tube, and is ideal for all heavy-duty mining, quarrying and construction work.

If you are not yet using Condor Homoflex Hose on your drills, get some from your nearest Manhattan Distributor. It's a good way to end hose kinking and assure peak drill production with a constant, full feed of air through the hose.

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose • Fan Belts • Brake Linings • Brake Blocks • Clutch Facings • Packings • Asbestos Textiles • Powdered Metal Products • Abrasive & Diamond Wheels • Bowling Balls



Are you paying

OLD-AGE COMPENSATION

for your obsolete pumps?

Check these three factors and see how much you can save by replacing outdated pumping equipment!

✔ CHECK YOUR POWER COSTS

and compare the efficiency and power requirements of your old pumps with those of modern I-R pumps. You may be amazed at how much you can save in power alone by replacing obsolete pumping equipment with today's more efficient I-R pumps. When one company recently replaced two old units with new I-R pumps the power bill dropped immediately from $1100 to $800 a month—*a saving of $3600 a year in power consumption alone.*

✔ CHECK YOUR MAINTENANCE COSTS

and see just how much it's costing you in both time and new parts to keep your old out-of-date pumps in operating condition. Today, lower maintenance is more important than ever before when it comes to keeping down your operating costs. And you'll find that *ease of maintenance—and less of it*—is inherent in the design and construction of I-R pumps. That's why they'll make such a big difference in your pump maintenance costs.

✔ CHECK YOUR PRODUCTION CHARTS

—They'll show you if your operations have lagged because of excessive "down time" brought on by pumps that can no longer keep pace with the modern high-speed processes of today. A higher availability status for your pumping equipment means higher production. You can depend on I-R pumps for continuous service because they're job engineered, *with design, construction, and materials to meet each specific application.*

Your nearest Ingersoll-Rand engineer will be glad to make a study of your present pumping equipment. He can help you determine if you have any pumps in service that can profitably be replaced by more modern, efficient I-R units.

Ingersoll-Rand

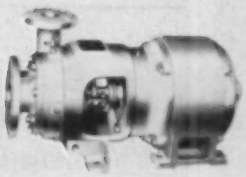
Cameron Pump Division

11 BROADWAY, NEW YORK 4, N.Y.

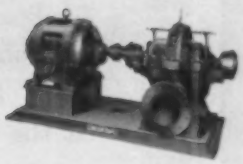
COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS
CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

532-10

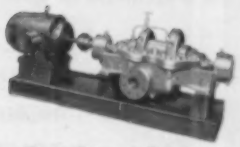
There's a COST-SAVING I-R PUMP for every liquid-handling job!



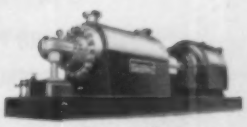
Motorpumps
Capacities to 1800 gpm
Pressures to 260 psi



Single-Stage Pumps
Capacities to 50,000 gpm
Pressures to 150 psi



Two-Stage Pumps
Capacities to 2200 gpm
Pressures to 450 psi



Multi-Stage Pumps
Capacities to 3000 gpm
Pressures to 3000 psi

Vertical Pumps
Capacities to 80,000 gpm
Pressures to 1500 psi

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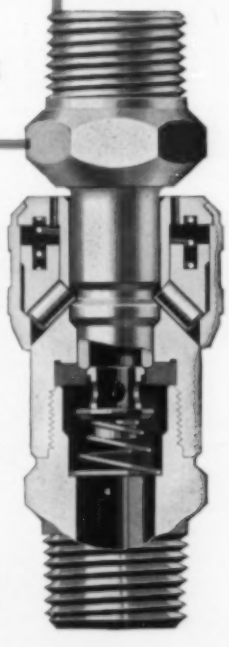

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